ENGINEERING NEWS-RECORD

SEPTEMBER 19, 1946

Sheet-metal hoods serve as air intakes for new factory at Tiffin, Ohio

In this issue:

[illegible]

ASPHALT UNDERSEAL HALTS PAVEMENT PUMPING

WHEN SEWAGE
"takes wings"
YOU NEED THIS PIPE

An aerial gravity line was indicated as the best means of transporting sewage across this river and into the main trunk sewer. And the engineers selected **Armco** Asbestos-Bonded Pipe for these important reasons . . .

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Underground, as well as in the air, you will find that **Armco** Asbestos-Bonded Pipe can solve many of your most vexing sewer problems. It withstands destructive vibration under highways and railroads, spans unstable or wet foundations, and can be placed in the deepest trenches. Where necessary this time-proved pipe can be jacked under busy streets without disturbing pavement or traffic. Write today for the Armco Sewer Book. Armco Drainage & Metal Products, Inc., and Associated Companies, 1375 Curtis Street, Middletown, Ohio.

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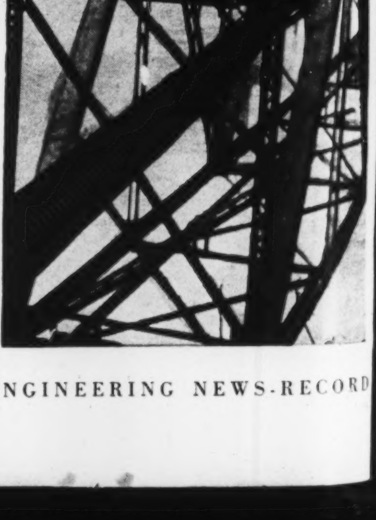

ARMCO

ASBESTOS-BONDED

Armco Sewer Pipe

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

Volume 137 • Number 12

September 19, 1946

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The index for Volume 136 (January to June 1946) will be mailed without further request to all those who ordered an index for Volume 135. Subscribers who wish the index and who did not receive the Volume 135 index or who have since changed their address should return this coupon.

The Editor, Engineering News-Record
330 West 42nd St., New York 18, N. Y.

Name ....
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This large hospital at Sylacauga, Ala., is built of architectural concrete. Architect was Charles H. McCauley, A.I.A. of Birmingham. General contractor, Algernon Blair of Montgomery.

With all its other advantages

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. . . through scientific research and engineering field work

Construction Trends

Construction Capital Gains 75 Percent Over 1945

New construction capital totalling $2,824,446,000, made available this year through the first half of September, is 75% greater than for the same period last year. Sale of state and municipal bonds rose 112% over 1945; investment in corporate securities gained 183%; Federal-Aid Highway appropriations increased 185%, while appropriations for federal construction rose 59%.

Federal construction appropriations, totalling $1,672,982,000 for the fiscal year July 1946-June 1947, comprise 59% of all new construction capital recorded by *Engineering News-Record*. Of this amount, more than half has been appropriated as a direct result of the War, $459,763,000 to Veterans' Administration for hospital construction, and $454,027,000 to National Housing Agency for veterans' housing. The War Department (Civil Functions) has received $259,682,000, 16 percent of the fiscal year's federal construction funds, of which $187,247,000 will be used for flood control work. An equally large sum, $189,360,000, has been received by the Department of the Interior for reclamation work. However, the rate at which this federal money will be spent will depend upon the lifting of the federal construction moratorium affecting work other than hospitals and veterans' housing.

NEW CONSTRUCTION CAPITAL
Jan. 1, 1946 — Sept. 12, 1946

State and Municipal Bonds	$ 593,526,000
Corporate Securities	332,938,000
Federal-Aid Highway	225,000,000
Total Funds for Non-Federal Construction	1,151,464,000
Federal Appropriations for Federal Work	1,672,982,000
New Construction Capital	$2,824,446,000

APPROPRIATIONS FOR FEDERAL CONSTRUCTION (JAN. 1, 1946 — SEPT. 12, 1946)

DEPARTMENT OF INTERIOR

Bureau of Reclamation	$ 189,360,000
Bureau of Indian Affairs	6,696,000
Bonneville Power Administration	8,470,000
Southwestern Power Administration	5,500,000
National Park Service	1,330,000
	$ 211,356,000

DEPARTMENT OF AGRICULTURE

Flood Control	$ 2,100,000
Soil Conservation	39,300,000
Water Conservation	1,025,000
Forest Roads and Trails	30,214,000
	$ 72,639,000

DEPARTMENT OF COMMERCE

Civil Aeronautics Authority	$ 48,600,000
	$ 48,600,000

NAVY DEPARTMENT

Bureau of Yards and Docks	$ 70,966,000
	$ 70,966,000

WAR DEPARTMENT—CIVIL

Flood Control	$ 187,247,000
Rivers and Harbors	72,435,000
	$ 259,682,000

WAR DEPARTMENT—MILITARY

Construction—Military Posts	$ 115,500,000
	$ 115,500,000

DISTRICT OF COLUMBIA

Schools	$ 2,298,000
Public Works	7,265,000
Sewer Division	2,300,000
	$ 11,863,000

VETERANS' ADMINISTRATION

Hospitals	$ 459,763,000
	$ 459,763,000

NATIONAL HOUSING AGENCY

Veterans' Housing	$ 454,027,000
	$ 454,027,000

FEDERAL WORKS AGENCY

Advance Planning	$ 47,000,000
Bureau of Community Facilities	72,000,000
	$ 119,000,000

FEDERAL SECURITY AGENCY

Howard University	$ 1,560,000
Engineering Surveys for Public Health Service	259,000
	$ 1,819,000

DEPARTMENT OF STATE

International Boundary and Water Commission	$ 9,350,000
	$ 9,350,000

DEPARTMENT OF JUSTICE

Federal Prisons	$ 600,000
	$ 600,000

TENNESSEE VALLEY AUTHORITY

Additional construction	$ 39,906,000
	$ 39,906,000
Total Appropriations for Construction	**$1,876,631,000**

RESCISSIONS

War Department	$ 13,328,000
Navy Department	190,000,000
Public Road Administration	321,000
	$ 203,649,000
Total Net Appropriations for Construction	**$1,672,982,000**

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News of the Week

ENGINEERING NEWS-RECORD • SEPTEMBER 19, 1946 • VOLUME 137 • NUMBER 12

Planned local public works now total over $1.4 billion

Federal Works Agency reports continued activity in planning community facilities despite restrictions on starting new construction at this time

Local planning groups have completed without federal assistance plans for $1,357,000,000 of non-federal public-works construction, and with advances from the Bureau of Community Facilities of the Federal Works Agency have completed plans for another $63,000,000 of similar construction. This planning is going ahead despite the current restrictions on construction so that an early start can be made on the work when the restrictions are lifted.

The Bureau of Community Facilities, through Aug. 31, had approved grants totaling $32,258,354 for the planning of 4,630 projects expected to cost $1,297,000,000, while requests for an additional $39,067,744 of aid for planning work expected to cost more than $1,460,000,000 are under review by the FWA bureau.

Much non-federal work

The total of $1,357,000,000 of work planned without federal assistance consists of 5,553 projects, and the overall figure includes land and right-of-way, equipment, and miscellaneous expenditures in addition to the cost of construction, the cost of construction alone being estimated at $1,125,789,000.

A breakdown of the larger figure reveals that the following amounts of work have been planned without federal assistance: sewer, water and sanitation facilities, $371,188,000; schools, $225,813,000; highways, roads and streets, $167,166,000; airports, $161,464,000; bridges, viaducts and grade separations, $88,174,000; hospitals, $71,564,000; other public buildings, $104,692,000; parks and recreational facilities, $38,455,000; and miscellaneous, $128,942,000.

Previous to Sept. 1, a total of 472 projects expected to cost $63,372,447 had been approved for advances from the Bureau of Community Facilities. Work in this class included $35,000,000 of sewer, water supply, and sanitation work; over $12,000,000 of school construction; more than $1,200,000 of hospitals and health facilities; nearly $5,000,000 of public buildings other than schools and hospitals; and over $4,500,000 of highways, roads and streets.

Many requests approved

Through Aug. 31, the bureau had received requests for advances totaling $71,326,098 for planning 7,560 projects with an overall cost of $2,757,000,000 and a construction cost of $2.2 billions. Of these requests, advances totaling $32,258,354 for the planning of 4,630 projects with a total cost of more than $1,296,000,000 had been approved. The advances granted are being used to prepare plans for a program expected to cost as follows: sewer, water and sanitation facilities, $546,355,941; schools and other educational facilities, $318,415,189; hospitals and health facilities, $73,470,874; other public buildings, $117,187,172; highways, roads and streets, $46,820,998; parks and other recreational facilities, $29,943,129; bridges, viaducts and grade separations, $28,426,458; airports, $19,895,981; and miscellaneous public facilities, $116,481,309.

Work for which applications for planning aid are pending includes: sewer, water supply and sanitation work, $468,000,000; schools and educational facilities, $314,000,000; hospitals, over $84,000,000; other public buildings, $188,000,000; roads and streets, $71,000,000; and bridges, $72,000,000.

The planning aid is being advanced under the direction of George Field, commissioner of the Bureau of Community Facilities. He reports that Congress to date has provided a total of $65,000,000 for the planning program. Of this amount, about $28,000,000 remains available for planning assistance to the local public works groups.

To be eligible for a grant, the local agency sponsoring a project must be able to show that it is financially prepared to start construction within four years with its own funds.

To discuss CAA airport money policy

All details of the Civil Aeronautics Administration's rules and regulations for use of federal money in airport construction will be open for discussion during the week of Oct. 28, T. P. Wright, administrator, said last week.

A bill authorizing federal aid to local governmental units for airport construction and rehabilitation was passed by Congress last May (*ENR* May 16, vol. p. 763), and since that time, a total of $45,000,000 was appropriated for construction. Of this total, nearly $31,000,000 has already been apportioned to the states for their use (*ENR* Aug. 15, vol. p. 199).

"Where the act speaks in sufficient detail," Mr. Wright commented, "there can be no discussion. However, the act does leave considerable room for policy decisions, and the CAA wants all who are directly concerned to have their say in establishing the final draft of regulations in this respect."

Invited to the hearings, in the order in which they will appear, are: The U. S. Conference of Mayors; American Municipal Association; National Institute of Municipal Law Officers; the Council of State Governments, and the National Association of State Aviation Officials. Other briefs may also be presented.

A set of tentative regulations appearing in the Federal Register last week, listed in detail the types of airport developments that will be eligible for aid. Forms are now available in CAA regional offices for preliminary project requests.

The proposed rules and regulations can be obtained at 15 cents per copy, from the Superintendent of Documents, Washington 25, D. C.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction—The Corps of Engineers awarded a $4,663,000 contract for construction of a 400-bed general hospital for the Veterans Administration at *Providence, R. I.*, to E. Turgeon Co., of Providence. . . . The *Seattle, Wash.*, "Post-Intelligencer" plans a $900,000 publishing plant. . . . Publicker Industrial Alcohol Co. awarded contracts totalling $1,000,000 for four warehouses to be built at *Linfield, Pa.* . . . Johns-Manville Corp. plans a $1,000,000 manufacturing plant at Tulton, N. H. . . . *Jefferson County (Birmingham) Ala.*, will build a $500,000 health building in downtown Birmingham. . . . Sears, Roebuck and Co. plans a $1,650,000 retail store and farm sales building in *Philadelphia, Pa.* . . . The *York, Pa.*, city school district has set up a $2,000,000 school construction program, but anticipates delays due to materials shortages. . . . *Fresno County, Calif.*, is considering a $3,500,000 expansion program at the county fairgrounds. . . . A $7,000,000 plant to manufacture chemical specialties is planned by the E. I. DuPont de Nemours and Co. at *West Toledo, Ohio*. . . . An extensive new construction program is planned at its *Fairfield, Ala.*, mill by the Tennessee Coal, Iron and Railroad Co. . . . The City of *Jacksonville, Fla.*, is planning a six-story city hall, to cost $1,650,000. . . . A growing shortage of cement is slowing construction programs at *Milwaukee, Wis.*

Water Supply and Sewerage—*Metamora, Ohio*, has awarded contracts for exploratory well drilling to find a steady source of drinking water. . . . *Blairsville, Ga.*, awarded contracts totalling $100,000 for construction of additions to its waterworks and sewerage disposal systems. . . . *Bremerton, Wash.*, plans construction of a $500,000 sewage treatment plant. . . . *Billings, Mont.*, awarded a $223,000 contract for installation of a 23 mg. settling basin as part of the city's water system development program. . . . *East St. Louis, Ill.*, city councilmen have voted to apply for a $65,000 federal fund to defray exp[illegible]ses of planning storm sewers to obviate recurrence of recent flash-floods in the area surrounding the city. . . . Water runoff throughout *Arizona*—a source of grave concern recently when irrigators and city water supply systems have reported record low storage—was generally above normal in July, according to the U. S. Geological Survey.

Highways—*Arkansas* has completed plans for some 197 highway projects to be let during the fiscal year 1947. . . . *Baltimore, Md.*, board of estimate members advised the State Roads Commission that the city opposed sharing costs of construction of a $1,000,000 bridge in Ann Arundel County leading to the city-owned Fort Smallwood park. . . . More than 1,000 permanent historical highway markers will be placed along *Pennsylvania* highways by the state Historical and Museum Commission. . . . During the first six months of 1946, some 836 miles of road improvement and reconditioning work had been placed under contract or completed by *Missouri*, at a total cost of $8,687,000. . . . The *Halifax, N. S.* metropolitan commission recently urged construction of a $15,000,000 highway bridge between Halifax and neighboring Dartmouth.

Bond Issues — *Vancouver, Wash.*, will vote Nov. 5 on a $600,000 issue for construction of an interceptor sewer system. . . . *Baltimore, Md.*, will vote in November on a $5,000,000 issue to finance highway and bridge construction. . . . *Perry, Okla.*, residents approved five propositions totalling $461,000 to finance work on sewage disposal facilities, waterworks extensions, and for a municipal hospital.

Housing—Surplus buildings at Camp Rucker, near *Ozark, Ala.*, and at Fort Barrancas, near *Pensacola, Fla.*, will be sold at public biddings through the Mobile District office of the Corps of Engineering. . . . Maurice Heiviel will build a 250-residence, $2,000,000 housing project near *Mt. Airy, Pa.* . . . Ground was broken recently for a $10,000,000 800-family housing project to be known as Hancock Village, between *Brookline* and *Boston, Mass.* . . . A $3,000,000 housing project will start soon at *Rock Island, Ill.*

Miscellany—Construction has started on the $822,000 Black Canyon pumping unit near *Caldwell, Idaho*, which will supply irrigation water to some 25,000 acres between Caldwell and *Emmett*. . . . Masons at *London, Ontario*, have demanded a wage boost to $1.40 per hour on an eight-hour day basis, with $15 per week allowance for board and lodging. . . . Valuation of real and personal property for tax purposes at *Minneapolis, Minn.*, increased by more than $33,000,000 during the past year. . . . A forecast of need for additional power dams on the *Columbia River* system was contained in a recent Bonneville Power Administration statement which warned that the administration may soon find it necessary to restrict power deliveries to private companies. . . . The reconstructed highway bridge across the Mississippi River at *Chester, Ill.*, was opened for traffic recently.

THE COVER PICTURE

The huge ventilator shown on the cover of this issue is on the roof of the new General Electric Co. factory at Tiffin, Ohio. It is one of many serving equipment that provides 22 changes of air per hour in the "semi-controlled" working areas, principally around the large annealing furnaces, to keep the temperatures down to comfort levels. Further details on construction of this plant are contained in an article beginning on vol.p. 360 of this issue.

Cleveland, Ohio plans $6 million water intake

The City of Cleveland, Ohio, is planning to build a four-mile water intake to cost $6 million to serve the northeastern section of the city and the suburb of Euclid.

G. W. Hamlin, Cleveland Water Commission, said that two years would be required for construction of the intake. Additionally, the city plans to build a $1,000,000 reservoir with a capacity of 20,000,000 gal. to provide further storage for the Euclid area.

The new intake from Lake Erie is expected to provide a solution of the problem of low water pressure which has been a source of much trouble in the fast-growing in the suburban district.

Building a toll highway across Ohio proposed

Construction of a four-lane toll superhighway costing $152,380,000 across Ohio between the Pennsylvania and Indiana borders was urged last week by State Senator Ralph A. Winter, who said he would introduce bills authorizing the work at the next legislative session.

Mr. Winter said he based his estimate of the cost of the road on a preliminary report made to him by a Baltimore, Md., engineering firm. He said the proposed road would be 293 miles long, and financed by road construction bonds to be issued by a proposed Ohio Turnpike Commission. Tolls would be collected to provide revenue for the commission.

Army Engineers defer $9 million building work

Deferment of $9,316,000 in important Army construction work, in compliance with recent orders for curtailment of construction (*ENR* Aug. 8, vol. p. 147) is provided in the War Department's construction program for the fiscal year 1947.

The deferred work was to have been performed both in the United States and overseas.

In a further move to comply with the building-limitation directive, plans have been made—subject to sanction by the Office of War Mobilization and Reconversion—to proceed with a $44,965,000 program of essential construction to provide housing within Army establishments in critical housing areas in the United States. Through this construction, a considerable amount of housing will be released to non-military home-seekers.

Under present Army plans, the program will apply largely to conversion of excess troop barracks to on-post family quarters.

◆

Texas to vote on controlling gas tax use

Among items to be considered by Texas voters at the Nov. 5 election is a constitutional amendment that may make the state the nineteenth to prohibit diversion of highway-user taxes, according to the American Road Builders' Association. The amendment would direct that all state taxes collected from gasoline and oil sales be used only for highway work.

The first such measures to be adopted went into effect in 1919, in Oregon, Colorado, New Mexico and North Dakota.

◆

Highway transport body plans national meeting

Meeting under the auspices of the National Highway Users Conference, a National Highway Transportation Congress will be convened September 26 and 27 at Washington, D. C.

Main work of the Congress will be to draw up a positive program of action and policies to assist highway-using groups in solving problems of postwar highway transportation.

Speakers will include leaders in the motor transport, automotive machinery and allied fields.

Freight space shortage blocks lumber

Current shortages of freight car space may have serious consequences on the availability of lumber for construction, the Civilian Production Administration said in its monthly report for August, issued last week.

The lumber industry's production has been exceeding three billion board feet per month for two months, CPA said, but this near-capacity output means very little if shipments cannot be made. "The present shortage of railroad cars in the west will have serious consequences if it continues through the balance of the harvesting season as now feared," CPA said. "In conjunction with private and governmental shipping authorities, CPA has been engaged in measures to relieve the tie-up through greater use of trucks and of shipping by water, but some problems do remain."

The same freight-car shortage may throw all calculations off on production and distribution of softwood plywood, despite the fact that the industry is producing about 30,000,000 sq. ft. per week.

Surveying other critical construction materials, CPA said that Portland cement, formerly considered one of the few building materials in easy supply, had recently become critical over broad areas of the country, principally in Miami, Florida, and Portland, Oregon.

Output of common and face brick passed the 400,000,000 mark in July for the first time since 1941, and CPA statisticians said that "On an over-all basis, it appears that brick production during the winter lull in construction should be sufficient to take care of use requirements and allow some stock to be built up in anticipation of the 1947 building season." At present, however, brick is still generally in short supply, the report said.

Clay sewer pipe production was said to be well above prewar production, but production of cast iron sewer pipe is still considerably below the prewar levels and current requirements.

For the second successive month, the reports show that the production of plumbing fixtures failed to attain the post-war highs, and bath-tubs, sinks and bowls remain in very short supply. Output of electrical wiring devices also declined, and wire insect screen cloth is still critically short, the report concluded.

Chicago sewer bid close to estimate

The low bid of $9,492,450 submitted Sept. 12 by S. A. Healy Co., Chicago, for contract No. 2 of the South Side intercepting sewer was extremely close to the estimate of the Sanitary District of Chicago, according to William H. Trinkaus, chief engineer and general manager.

The contract calls for 17,000 lin. ft. of 18x20-ft. reinforced-concrete sewer in tunnel. One other bid was received for $9,991,000, tendered jointly by Peter Kiewit Sons and Paschen Contractors, Inc., Chicago.

Contract No. 1 of the same project is now under construction by S. A. Healy Co. This contract, for 23,000 ft. of similar tunnel sewer, was awarded Nov. 21, 1945, for $10,386,000. Contract No. 2 involves somewhat more difficult construction, as it intercepts two stretches of rock, whereas No. 1 cuts through only one rock section.

The two contracts form part of an intercepting sewer project about 70,000 ft. in length designed to drain 16½ sq. mi. on the South Side and relieve an overloaded sewer now carrying drainage from 27 sq. mi. Most of the projected sewer is 18x20-ft. section. All of the construction will be in tunnel.

OPA approves price rise for road machinery

Manufacturers of construction and road maintenance machinery have been given a price increase factor of 13.5 percent over base-date prices, the Office of Price Administration announced Sept. 16. Effective Sept. 17, the new price increase factor replaces an interim increase factor of 10 percent granted on April 10, so that it is actually only an additional 3.5 percent advance in ceiling prices.

Maintain 1936-39 profit ratio

The new increase factor is necessary, OPA explained, to enable manufacturers to earn their 1936-39 ratio of profit to net worth and is based on a survey of 31 companies. Included in the survey were the operations in the last quarter of 1945 of both large and small companies with sales covering the entire country.

At the same time, OPA authorized resellers of this equipment, which includes cranes, loaders, road maintainers, graders, mixers, pavers and many similar products, to pass on the manufacturers' price increase by increasing their prices the same percentage amounts as their costs are raised by the change.

PERSPECTIVE . . . .

Nuclear Power Plants

Plans for the construction of steam or hydro stations do not need to be abandoned for fear that they will be outmoded by the development of nuclear power. This appears to be the main conclusion to be drawn by civil engineers from the most recent report of Bernard N. Baruch, United States representative on the United Nations Atomic Energy Commission.

The Baruch report states that it appears probable that a nuclear power plant, using a modified Hanford-type pile, could be built. Based on current prices, such a plant to produce 75,000 kw. could be constructed in the eastern United States for about $25,000,000. On the assumption that the plant would operate at 100 percent of capacity, and that interest charges on the investment would be 3 percent, the bus-bar cost of power from the plant would be about 0.8 cents per kw.-hr.

Nuclear power not cheap

A comparable coal power plant would cost $10,000,000 under the same conditions. With coal costing $7 per ton delivered to the furnace, the cost of power from such a plant would be about 0.65 cents per kw.-hr., again on the assumption that the plant would operate at 100 percent capacity and that the interest charges would be 3 percent.

Equality of operating costs between the coal power plant and the nuclear power plant would be reached if the coal cost $10 per ton.

There is nothing in the Baruch report to indicate that nuclear power will ever supplant our great sources of cheap water power like Niagara Falls, Boulder and Grand Coulee dams or the St. Lawrence River. Firm power is being sold at Boulder Dam at 1.19 mills per kw.-hr. as against the 8.00 mills estimated for nuclear power.

The staff of the Monsanto Clinton Laboratories and the Monsanto Chemical Co. Engineering Department, which made the study for Mr. Baruch, points out that these costs are predicated on the successful solution of a number of difficult technological problems. The technical staff also point out that all the plutonium formed would be recovered for later consumption in the pile. No attempt would be made to produce plutonium for use elsewhere. Radioactive isotopes would be a byproduct, but they would probably have little effect on the economics of power generation.

Decentralization of Industry

The Baruch report and much of the newpaper comment on it lays emphasis on the possibilities for decentralization of industry that might be an outgrowth of the development of nuclear power. The Baruch report says: "Nuclear power plants would make feasible a greater decentralization of industry, a desirable factor in the world economy. Only a trivial amount of fuel need be brought in, and the need for a large cooling water supply might be obviated by the development of gas turbines."

Information about the Hanford plant is very limited, but apparently it now uses very large quantities of water for cooling pumps. Consequently, it seems logical to conclude that until gas turbines are developed that could be used in a nuclear power plant, such plants could not be counted upon for sources of power in areas far removed from sources of fuel or cooling water.

Less labor now required to produce cement

Manufacturing operations required about 12 percent fewer man-hours in 1945-46 to produce 100 bbl. of cement than 12 years ago, according to a new type of survey started recently by the Bureau of Labor Statistics. This study is the first of a series on labor requirements in the industries which supply important building materials and was made by the Division of Construction and Public Employment.

The 52 cement plants surveyed were producing at an annual rate of about 47.5 million bbl. during the period covered. At this level, a year's output would require a total of about 23 million man-hours of employment at the plants, or 48.4 man-hours per 100 bbl. produced. A previous study made in 1934 showed 55.0 man-hours per hundred bbl. for the same operations.

Penna. acquires lands in river desilting plan

A major forward step in the program of the State of Pennsylvania for cleaning up the silt-laden waters of the Schuylkill River was marked last week when the state formally became owner of the Schuylkill Navigation Company, which had controlled some 90 miles of properties along the river.

The agreement also terminated operation of the Schuylkill Canal, which was opened about 1825 between Philadelphia and Port Carbon for transport of coal to large industrial centers. The canal has been virtually abandoned since parallel rail lines were built.

Earlier practices of mining coal, dumping silt and other refuse into the river and the canal, are largely blamed for present-day restricted channel conditions in the river.

Calendar of Meetings

NATIONAL

Building Officials Conference of America, annual convention, Peabody Hotel, Memphis, Tenn., Sept. 30-Oct. 3.

Institute of Traffic Engineers, annual meeting, Deshler-Wallick Hotel, Columbus, Ohio, Oct. 3-5.

Federation of Sewage Works Associations, 19th annual meeting, Royal York Hotel, Toronto, Canada, Oct. 7-9.

American Society of Civil Engineers, fall meeting, Continental Hotel, Kansas City, Mo., Oct. 16-19.

Associated General Contractors of America, Inc., fall meeting, Benjamin Franklin Hotel, Philadelphia, Pa., Oct. 21-22.

National Council of State Boards of Engineering Examiners, 25th annual meeting, Hotel Statler, St. Louis, Mo., Oct. 27-29.

American Institute of Steel Construction, annual convention, Del Coronado Hotel, Coronado, Calif., Oct. 28-31.

REGIONAL

American Water Works Association, Southwest Section, Buccaneer Hotel, Galveston, Texas, Oct. 14-17.

American Water Works Association, New England Section, Parker House, Boston, Mass., Oct. 17.

American Water Works Association, West Virginia Section, Hotel Morgan, Morgantown, W. Va., Oct. 17-18.

American Water Works Association, California Section, Whitcomb Hotel and Civic Auditorium, San Francisco, Calif., Oct. 23-25.

American Water Works Association, Kentucky-Tennessee Section, Andrew Johnson Hotel, Knoxville, Tenn., Oct. 28-30.

Pennsylvania Water Works Association, Golden Anniversary meeting, Hotel Traymore, Atlantic City, N. J., Oct. 15-18.

A bargaining plan for civil service proposed in New York transit report

Advisory committee to the Mayor of New York favors a system closely approaching collective bargaining in private industry

Granting of collective-bargaining rights closely approaching those now accorded employees of private industry to the 35,000 employees of the Board of Transportation of the City of New York was recommended to Mayor William O'Dwyer on Sept. 9 by the Mayor's Advisory Transit Committee.

The board also recommended that all hourly wage rates of the New York City subway system be increased by 20 cents. The top rate for operators in the New York system now is $1 an hour. The Transport Workers Union (CIO), which inaugurated the movement that resulted in the appointment of the advisory committee, asked for an increase to $1.25.

Pay for annual employees

With respect to the 2,800 annual-rate operating employees, the committee recommended for all employees other than those in an executive capacity an increase corresponding to the increase granted to the hourly paid employees, about $480 a year.

No similar increases were recommended for the 2,269 annually-rated administrative employees engaged in performing clerical, office and professional duties whose "civil service classifications have always been and still are identical in job title and salary range with those of about 100,000 employees in other city departments," because these employees, in the past, uniformly have been treated as part of the 100,000 group.

The five-cent fare

While the problem of an increased fare was not before it, the committee called attention to the fact that its recommendations called for an increased expenditure of approximately $17,500,000 and that as debt service for the year ending June 30, 1947, will amount to $57,000,000, there will be an average deficit of three cents for every passenger who pays his five-cent fare on the transit system in that year.

In public employ, the committee said, the possible area of collective negotiations regarding wages, hours and working conditions is restricted. The essential attributes of civil service may not properly be changed by collective negotiations. The rules governing hiring, promotions and discharges cannot be open to amendment by negotiation without doing violence to the Rapid Transit Law, the merit system, and the Constitution of the state itself. "It follows that many of the other normal incidents of the relationship between the employer and employees in private industry, such as the closed shop, are not available to employees of the board. . . . Despite such limitations, there still remains in the field of negotiations the question of wage income hours, working conditions, and the disposition of grievances.

"Government employees do not share in the benefits of our labor relations acts—national and state. Collective bargaining, as it has come to be understood in private industry, is mandatory under those acts. It does not follow, however, that voluntary negotiations should be denied to government employees. The virtues of collective bargaining do not flow from the compulsions of laws. In our judgment, the principles and procedures of our labor acts should be applied, within the appropriate area and to the extent possible, to all public workers, as well as private."

No exclusive representation

The committee noted that the Mayor, acting on advice of the corporation counsel, had rejected the principle of exclusive recognition of any organization for all employees of the Board of Transportation, and said that it, too, is of the opinion that exclusive recognition for the entire system should not be granted. It favors adoption of a system whereunder a majority of the employees in an appropriate unit may select an agent to act as exclusive representative in collective negotiations for all employees in that unit. Ultimately, the units might all agree on representation by one union, or they might favor representation by two or more unions.

Bargaining between the unions and the board should be conducted annually, the committee states,

As the committee believes that compulsory arbitration between the board and its employees is incompatible with the board's complete authority over wages and working conditions, it recommends that if the board and a union cannot agree, the union may request review by a panel appointed by the mayor. Following hearings by the advisory panel, the panel's recommendations would be made public, but they would not be binding on the Board of Transportation.

A civil servant who joins in a strike, the committee said, is in a different position from that of a private employee; he is subject to charges of delinquency and misconduct.

No right to strike

"We recommend that the board make clear that it will not tolerate strikes, and that strikers, individually and collectively, will strike at their peril.

"It may be argued that effective collective negotiation is not possible without either the power to strike or the right to secure legal binding arbitration. The integrated demands of a group of 33,000 men, however, represents a considerable force. When to this force is added the persuasion of advisory review with its impact on public opinion, collective negotiation will, in our judgment, operate effectively, even though the final step of trial by combat is denied.

"There remains, of course, the difficult problem of the practical application of the board's punitive powers in the event of a strike. We have recommended the assertion of these powers because we believe that a clear statement of policy will discourage hasty threats and hasty action. It would, however, be unrealistic to conclude that a legal right is always a practical remedy. Although we favor giving the fullest possible effect to the use of sanctions, we believe that a no-strike policy will find important, additional support in the workers' sense of justice.

"The right to strike has been labor's most potent weapon. The fiat which denies that right throws on the government agency which pronounces it a correlative duty of fair dealing with its affected employees. Those who at the behest and in the interest of the state forbear to lay down their tools should be treated at least as well as comparable workers who may fully exert their collective power. The board's denial of the right to strike and the board's obligations to its employees are complementary."

The Mayor's Advisory Transit Committee is made up of Arthur S. Meyer, chairman, New York State Board of Mediation; Theodore W. Kheel, executive director, National War Labor Board; Edward P. Mulrooney, former police commissioner of New York; Anna M. Rosenberg, regional director, War Manpower Commission; and Samuel I. Rosenman, former special counsel to Presidents Roosevelt and Truman.

Two states ask surveys of beach erosion damage

The newly signed federal law permitting use of government funds to finance up to one-third the cost of beach erosion projects (*ENR* Sept. 12, vol. p. 340) last week brought a request to Gov. Raymond Baldwin of Connecticut to urge an overall study of the state's coast line problems, and resulted in plans for similar studies of lake-shore damage in Ohio.

The Connecticut Beach Erosion Committee, created July 26, is already making a preliminary survey of erosion conditions. Committee members requested Governor Baldwin to recommend that the Beach Erosion Board of the Corps of Engineers make an overall study and plan correction of the state's erosion problems.

A resolution recommending a $6,000,000 state appropriation for erosion control along Ohio's Lake Erie waterfront was among 14 recommendations adopted at a recent meeting of the Lake Erie Erosion Committee of the Ohio Postwar Commission.

Committee members said that the sum would cover only the "most critical areas" and would be used only on publicly owned land from the improvement of which the general public will derive the most benefit.

◆

New York to expend $6 million for hospital

The Postwar Public Works Planning Commission of New York State said last week that it had approved the expenditure of more than $6,500,000 on new construction for the Harlem Valley State Hospital, at Wingdale, in Dutchess County.

The projects include a medical and surgical building, a building for disturbed patients, an addition to the hospital's power plant and six staff residences. The hospital was established to relieve serious congestion in hospitals for the mentally ill in New York City. Frederick MacCurdy, State Commissioner of Mental Hygiene, pointed out that even as long ago as 1930, the hospital was reported to be over-crowded.

The medical and surgical building alone is to cost about $3,699,000; the building for disturbed patients, $2,328,000; addition to the power plant $487,000, and staff houses, $84,000. The architectural firm of McKim, Mead and White of New York City has been engaged as architects on all projects except the staff housing.

ENGINEERING SCHOOL NEWS

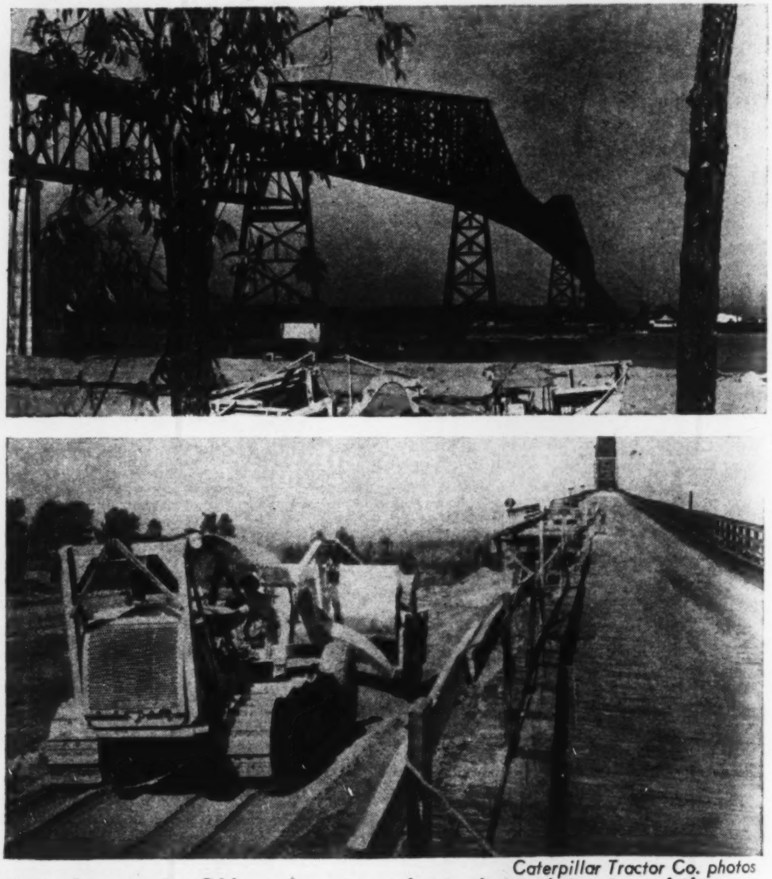
Abel Wolman, professor of sanitary engineering at Johns Hopkins University, has announced the opening of a new sanitary laboratory under the jurisdiction of the Department of Sanitary Engineering.

The laboratory is designed for graduate study and research in sanitary engineering and water resources problems —particularly those relating to the chemistry and biology of water supplies, sewage disposal systems, polluted waters, industrial wastes and the ecology of estuaries. The laboratory will be operated under the direction of Charles E. Renn, formerly associate bacteriologist of the Massachusetts Department of Public Health, division of Sanitary Engineering.

Samuel C. Lind, dean of the University of Minnesota Institute of Technology, will retire July 1, 1947, when he reaches the statutory retirement age. Dean Lind became head of the school on its formation in 1935.

Members of the School of Civil Engineering of Georgia Tech, at Atlanta, Ga., have obtained space in the school's engineering building for a memorial library dedicated to William A. Hansell, former assistant chief of construction for the city of Atlanta. Many engineering books and a number of historic city designs and records have been donated to the collection.

Arthur Cutts Willard formally became president emeritus of the University of Illinois as of Sept. 1, when he was succeded as president by George D. Stoddard. Dr. Willard served as president since 1934, when he was elevated to the post from his former position as dean of the college of engineering.



Caterpillar Tractor Co. photos

New Approach*—*Old wooden approaches to the steel structure of the spectacular Longview Bridge over the Columbia River near Longview, Wash., are being replaced piecemeal with a new rock and sand fill. The fill eventually will contain 52,000 yd. of rock and 180,000 cu. yd. of sand core. Sand is being obtained from deposits along the river shore.

Increase in water rates forecast at Southeast section, AWWA meeting

Raise said to be necessary to meet higher costs of labor and materials—Public relations program suggested.

An increase in water rates was forecast at the eighteenth annual meeting of the Southeastern Section of the American Water Works Association held Sept. 9-11 in Savannah, Ga. The rise will be necessary to meet increased costs of labor and materials.

Much new work needed

William W. Brush, treasurer of the national body, told the more than 150 water-supply engineers attending from the Southeastern States that higher rates are necessary if present costs of operation and construction are to be met. He declared that water utilities formerly spent $120,000,000 a year on new construction and will need to spend $250,000,000 a year now to cover increased material and labor costs. "When the influence of present labor wage policies have become fully effective, this cost will probably exceed $250,000,000 annually," he said.

Better public relations needed

Harry E. Jordan, secretary of AWWA, proposed a broad-public relations program in which the residents of the community would be informed of the difficulties involved in obtaining materials and supplies to expand systems and to provide service to new homes. He said that such a policy of information would win their patience until service can be given.

As indicative of the number of house connections to be installed, Mr. Jordan pointed to the 384,000 permanent housing units started by Aug. 1, and to the 602,000 total of all units under way on that date. In addition to this, he stated that there was deferred maintenance, amounting to $125,000,000 on VJ-Day. Unless the National Housing Administration sets up direct allocation of pipe and service-line materials, Mr. Jordan said, all the housing units this year cannot be provided with water service.

Reduction of scale

J. A. Holmes, National Aluminate Corp., Chicago, discussed the practical approach to scale deposition in potable water supplies. He recommended, if stability is between 6.0 and 4.0, the use of a polyphosphate type of treatment. Below about 4.0, when the tendency for scale formation is great, he said that it is advisable to presoften or otherwise lessen the effect of one or more of the factors on the side of the balance that causes scale to the point where an economical dosage of polyphosphate treatment can then be employed.

Based on field experience, Mr. Holmes said that his opinion is that silica naturally present in water is a better protector against corrosion than added sodium silicates.

F. W. Chapman, superintendent of the Greenwood, S. C., Water Department, described the use of chlorine dioxide in his water supply system. The city draws its water from a shallow artificial lake. There has always existed a taste and odor problem, which is much worse in warm weather. Numerous treatments were used until October, 1944, when a chlorine dioxide generator was installed. Tastes and odors disappeared when this treatment was applied to the water, reported Mr. Chapman.

Industrial water for Savannah

Savannah's proposed industrial and domestic water supply plant was discussed by R. R. Adams, of J. E. Sirrine Co., designers of the system.

Other topics considered were modern distribution shop practices, by R. E. P. Woodward of the Macon Water Department, and the use of aluminum in water-works structures, by John Perryman of R. D. Cole Co., Newman, Ga. A sound movie prepared by the Cast Iron Pipe Research Assn. was used to illustrate modern methods for installing cast-iron pipe.

W. H. Weaver, general manager of the DeKalb County Water System, Decatur, Ga., was elected section chairman; W. R. Wise, of South Carolina, was elected vice-chairman, and W. T. Linton, sanitary engineer of the South Carolina Board of Health, was elected secretary, to fill the vacancy of B. P. Rice, who retires after nine years in office.

The Florida section of the American Water Works Association will join with the Cuban section in a meeting in Havana, Nov. 22, 23 and 24. Invitations have been extended to all AWWA members in Central and South America. C. F. Wertz, chairman, and A. P. Black, secretary, of the Florida Section are in charge of arrangements.

New order aids delivery of housing supplies

A new regulation announced Sept. 13 by Housing Expediter Wilson W. Wyatt provides special assistance to builders, and producers of both materials and factory-built housing in obtaining surplus materials and equipment from the War Assets Administration.

Designated Housing Expediter Priorities Regulation 4, the new order permits a builder to secure a certificate giving virtually a top priority in the purchase of specified surplus items held by the WAA.

Such directives and certificates may override action of the War Assets Administrator in setting aside certain types of surplus property for sale exclusively to veterans regardless of the use to which the property is to be put. Mr. Wyatt said that the purpose of issuing Housing Expediter Certificates under the new regulation will be to assure that as much as possible of the government-owned surplus suitable for the construction of homes is channeled into the veterans housing program.

Items of construction equipment to be made available to certificate holders out of WAA government-owned surplus include: Track-laying tractors, wheel tractors of 100 hp. or more, tractor type scrapers, portable air compressors, batching plants, rock crushers of 25 tons per hr. or under, ditching machines, cranes and motor graders. Other items for which certificates may be issued include production materials, construction materials, and maintenance, repair, or operating supplies of all kinds.

An applicant for a certificate should file two copies of Form NHA 14-82 with the regional housing expediter in the National Housing Agency region in which he does business. The new regulation provides the procedure for determining those who qualify for items of production materials, construction material, capital equipment or items needed for maintenance and repair.

Private Housing Advances

Meanwhile, about 41,000 new privately-financed permanent dwellings were completed in July, according to the Bureau of Labor Statistics of the Department of Labor. This was the largest number made ready for occupancy in non-farm areas in any month since the beginning of the Veterans Housing Program (*ENR* Jan. 10, vol. p. 13). The figure covers both conventional and prefabricated units, but excludes thousands of trailers and units created by conversions, all of which are included in the program.

Cities reject bonds for improvements

San Antonio, Texas, voters turned down $9,000,000-Bond — Missouri town refuses construction of own power plant

San Antonio, Texas, early in September voted almost 4 to 1 to defeat a $9,000,000 bond issue designed primarily to finance sanitary and storm sewer improvements.

At the same time, reports from the town of Washington, Mo., said that voters had "overwhelmingly" defeated a proposition for issuance of $659,000 in revenue bonds to finance construction and equipment of a municipal light and power plant.

The propositions were among several major bond programs defeated at recent elections, notable among them being a $44,000,000 issue at Los Angeles County, Calif. (*ENR* Sept. 12, vol. p. 335) which would have financed construction of a new courthouse, a jail, and an incinerator program.

The San Antonio election results marked the second defeat within recent months of efforts to improve the city's admittedly inadequate sanitary system, which received unfavorable publicity during the past summer's epidemic of poliomyelitis.

Need for a larger and better system of sanitary sewers was not disputed during the latest bond campaign, but opposition centered on the proposition's failure to limit the tax rate that could be imposed by the Bexar County Metropolitan Water District.

The proposition as submitted to voters included provision of funds for the purchase of the bonds of the San Antonio, Alamo Heights and Olmos Park sewer districts.

At Washington, Missouri—a town of 7,500 persons—voters by a margin of about 4 to 1 defeated a proposition for construction of a municipal light and power plant. The town is now served by the Union Electric Co. of Missouri. Opponents of the program pointed out that engineers' estimates of $659,000 as cost for the plant were made last winter and that prices have increased substantially since that time.

◆

Approve gas pipeline to serve St. Louis

The Federal Power Commission has authorized the construction of a 265-mile 22-in. diameter, natural gas pipe line between Monroe, La., and St. Louis, Mo., by the Mississippi River Fuel Corporation of St. Louis.

Estimated cost of the line is $11,574,000.

The new pipe will parallel more than half the length of the company's present 431-mile line, and will increase the St. Louis natural gas supply by about 40 percent.

The corporation, which has prepared plans and specifications for the project through its own engineering forces, will purchase the pipes and other materials direct, and when these have been obtained, will let construction contracts.

◆

R. H. Shreve dies, was architectural firm head

Richmond Harold Shreve, 69, a member of the firm of Shreve, Lamb & Harmon of New York City, died Sept. 9 at his home in Hastings-on-Hudson, N. Y.

One of the nation's best known architects, Mr. Shreve and his associates designed the Empire State Building in New York; the Vladeck and Williamsburg houses—New York's first public housing project—and the Metropolitan Life Insurance Co.'s housing communities in New York. His firm also designed the General Motors', Bankers Trust and the Insurance Co. of North America buildings, and during the war planned and supervised construction of Army bases and airfields and other installations in Newfoundland, northern Canada and Greenland.

Mr. Shreve was president of the American Institute of Architects from 1941 to 1943, and served as chairman of the International Congress of Architects in 1939. Fifteen years ago, when architects in several parts of the country undertook to use their license laws to restrict the activities of engineers in the building field, Mr. Shreve took an active part in checking the movement and in reaching an understanding with engineers that resulted in each profession writing into its registration laws an exemption for registered members of the other.

A native of Cornwall, Nova Scotia, Mr. Shreve was graduated in 1902 from the College of Architecture at Cornell University. He taught at the university for four years, and then joined the firm of Carriere & Hastings, in which he later became a partner. In 1924, with William F. Lamb, he established the forerunner of the present firm.

RANDOM LINES from an editor's notebook

. . . In which Oregon's freedom from frost damage to highway pavement is explained in detail.

"Pavement damage from frost is largely eliminated in this state," said R. H. Baldock, chief engineer, Oregon State Highway Commission, "by use of an adequate depth of porous material in the subgrade." This sounded like the text of a sermon—a sermon that might help to decrease frost damage in other states, so we asked him to explain how and why. What he said should carry weight because in Oregon's frigid mountain passes are pavements that endure, season after season, with no trace of frost boils or mud pumping.

Several factors combine, Mr. Baldock explained, to create a situation in which low temperatures are likely to destroy pavement. It is not sufficient to provide standard drainage ditches and place the pavement on a dry subgrade unless steps also are taken to prevent moisture from being drawn up into that subgrade by capillary action. Temperature changes in the pavement can be transmitted by tightly packed soil in the subgrade and the resulting capillarity may draw moisture up even from ground water levels at considerable depths.

Common destructive results of such capillary action, he pointed out, are the so-called frost heaves in which the pavement is forced upward by the expansive force of freezing water. Once frost heaves have formed it only remains for traffic to complete the destructive process. Mud pumping, which comes about after the thaw has turned the frost into liquid, may also be highly destructive by forcing the water to surge through the subgrade under hydraulic jack action. This action can be violent indeed as the result of slight movements of the pavement under the impact of heavy, fast-moving traffic.

The Oregon method of preventing these several kinds of destructive action is simply to provide adequate depths of crushed rock or gravel beneath the pavement. Where the frost menace is particularly bad, a depth of 30 in. or more of porous material in the subgrade is usual practice. The larger interstices in such a subgrade break up and prevent capillary action which is inversely proportional to the size of the interstices—N.A.B.

OBITUARY

Samuel D. Sarason, 63, former professor in the college of engineering at Syracuse University, died in Syracuse, N. Y., Sept. 10. Born in Russia, Professor Sarason was graduated from the Sheffield Scientific School at Yale University in 1905. After that he was a civil engineer for the Pennsylvania Railroad at Philadelphia. In 1906-10 he served the U. S. Coast and Geodetic Survey in this country, Alaska and the Philippines. He joined the Syracuse faculty in 1910 and retired in 1938.

Alfred H. Moore, 73, who had served as city engineer of Indianapolis, Ind., and was founder of the engineering firm of Moore and Jesup died Sept. 8.

George Alfred Brown, 87, graduate in civil engineering, University of Michigan in 1881, who was engaged in civil engineering projects in Pennsylvania, Indiana, California, Nevada and Oregon from 1881 to 1896, and served several years as a civil engineer on the Southern Pacific Railroad, died Sept. 5 at Bloomington, Ill.

Gordon Row Moore, 39, of Bismarck, N. D., senior engineer for the U. S. Geological Survey, died recently. Formerly he was with the State Highway Department.

Edward W. Hahn, 57, New Hampton, Iowa, county engineer for Chickasaw County for the last seven years, died recently. He was a graduate of the University of Wisconsin.

◆

New York begins study of anti-pollution laws

Acting to collect background data for a complete program of stream pollution regulations, a sub-committee of the New York State Legislature held the first of a series of open meetings at Syracuse, Sept. 10.

A series of similar conferences have been scheduled for other areas in the state, as part of a program to gather background information for subsequent legislative action (*ENR* Aug. 1, vol. p. 137).

Assemblyman Harold C. Ostertag, chairman of the Joint Legislative Committee on Interstate Cooperation, said that the Sept. 10 conference brought together industrialists, conservationists, sportsmen and local officials with a view toward establishing the extent of pollution problems in the Syracuse and Mohawk Valley areas and enlisting their cooperation in a program of pollution abatement. A second conference will be held at Utica on Sept. 19 to deal with pollution problems in Hamilton, Herkimer, Oneida, Fulton and Montgomery counties.

A sub-committee conducting the hearing directly is headed by State Senator Chauncey B. Hammond of Elmira; and the sub-committee consultant is Morris Cohn, chairman of the Mohawk Valley Sanitation Council and sanitation engineer for the City of Schenectady. In addition, the state commissioners of health, conservation, agriculture, commerce, taxation and finance, and the attorney general are representatives on the committee.

New York state at present does not have an integrated state program authorized by specific law for pollution abatement, although programs carried out by individually state departments and by many communities have had "successful" results locally.

◆

Army engineers shift some regional offices

Effective Sept. 5, the headquarters of the Ohio River Division of the Corps of Engineers are located at 309 Vince St., Cincinnati, Ohio. The division offices were located at Columbus.

The headquarters were located in Cincinnati before the war, but were moved to Columbus for military reasons. The division is composed of five districts including Cincinnati; Huntington, West Virginia; Louisville, Ky.; Nashville, Tenn., and Pittsburgh, Pa.

Merge New England offices

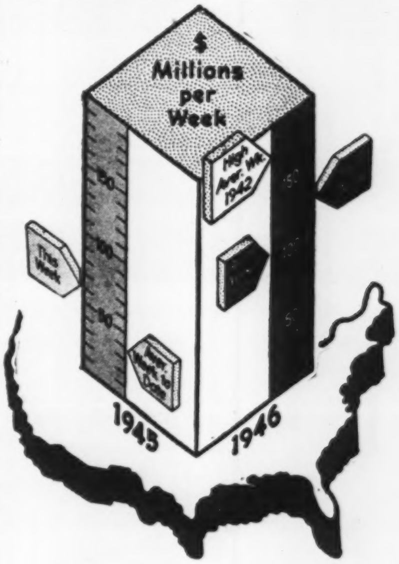
The Office of the Chief of Engineers at Washington last week also announced the discontinuance of the Providence, R. I., and Boston, Mass., district engineer offices, as of Oct. 1.

Operations of the two offices will be consolidated in the offices of the New England Engineer Division, at Boston. A sub-office will be maintained at Providence.

◆

The engineering firm of Techo Eterno Eureka, S.A., of Mexico City, has been awarded a $4,532,000 contract to modernize and mechanize the port of Veracruz. The contract calls for new piers, additional docks and warehouses.

CONSTRUCTION ACTIVITY



As Reported this week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Sept. 19 1946	Cumulative 1946 (38 wks.)	Cumulative 1945 (38 wks.)
Federal	$1,052	$520,178	$670,556
State & Mun.	32,903	1,028,721	244,335
Total Public.	$33,955	$1,548,899	$914,891
Total Private	90,796	2,458,188	492,546
U. S. Total	**$124,751**	**$4,007,087**	**$1,407,437**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (38 wks.)	Cumulative 1945 (38 wks.)
Waterworks	$1,106	$74,757	$39,353
Sewerage	1,866	73,031	23,172
Bridges	3,353	101,466	23,700
Highways	12,119	589,325	160,238
Earthwork, Waterways	1,258	292,951	37,008
Buildings, Public	10,166	288,475	410,490
Industrial ...	54,025	795,904	308,205
Commercial ..	30,525	1,503,844	118,944
Unclassified ...	10,333	287,334	286,327

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (38 wks.)	Cumulative 1945 (38 wks.)
NON-FEDERAL	$1,167,164	$576,935
Corporate Securities	348,638	120,571
State and Municipal	593,526	292,764
RFC Loans	......	24,600
REA Loans	......	60,000
Fed. Aid Highway	225,000	79,000
FEDERAL	1,672,982	1,049,898
Total Capital........	$2,840,146	$1,626,833

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	Sept. '46	360.19	173.14
Building Cost.....	Sept. '46	272.04	147.06
Volume	August '46	258	113

EDITORIALS

VOLUME 137 NUMBER 12

Sept. 19, 1946

Strikes in Public Service

THE URGENT NEED for a system of collective bargaining for public service employees was noted in these pages two weeks ago (*ENR* Sept. 5, vol. p. 291). Since then, such a system has been proposed by the Mayor's Advisory Transit Committee at New York. This committee, which was made up of able lawyers and labor authorities, reasserts the public employee's lack of the right to strike or to demand a closed-shop agreement with a public agency; but it holds that effective collective bargaining by government employees still is possible and should be inaugurated. The committee's proposals for such bargaining are summarized in the news pages of this issue. As we observed two weeks ago, whether or not such a system will work depends on widespread public acceptance of the need for it and upon its equitable administration by public bodies. As this committee so aptly says with respect to employees of the Board of Transportation at New York: "The board's denial of the right to strike and the board's obligation to its employees are complementary." If any program to prevent strikes by government employees, or by employees of privately owned public utilities, is to succeed, the public service employees must have clear evidence that the surrendered right has been offset by a form of collective bargaining at least equal and probably superior to that of workers who still have the right to strike.

Better Than Mud-Jacking

AFTER EXTENSIVE TESTS of asphalt as a material for raising settled pavements and for sealing joints to prevent "pumping", engineers of the Texas State Highway Department have concluded that asphalt is superior to soil mixtures for such work (See p. 90). Similar conclusions have been reached in Virginia, which work will be reported in a later issue. Ohio has been using asphalt to stop pumping at joints since 1942. The work in all three states marks a long step forward in research directed toward solving one of the major highway maintenance problems, which was first attacked in Iowa in 1930. Slurries made of mixtures of soil, cement and water were first used, being forced under the pumping joints or settled slabs with crude equipment. Since then, it has been found that limestone dust and slow-curing asphalt oils improved the slurry. Equipment and methods of application also were bettered. Now, substitution of a hard asphalt for the soil-base slurry has been found to increase the effectiveness of the process. Presumably it adds also to the cost, although comparable cost figures are not yet available. It should be observed, however, that any method for checking pumping at joints and settlement of pavements is a palliative. What is needed most is a cure in the form of a pavement and subgrade design that will make mud or asphalt jacking unnecessary.

Circles of Stress

MOST COLLEGE COURSES in strength of materials include at least one geometric method for finding the stresses in a loaded body on a plane inclined to one on which stresses are already known. Perhaps the most well-known of these constructions is the so-called Mohr's circle. That this circle has been derived in many ways by various men is shown in an article elsewhere in this issue. While there is some argument as to whose name should be affixed to the construction, there is no doubt as to the simplification of stress, strain and moment of inertia transformation problems made possible by its use. In many cases, a combination of the graphical method with algebraic computations may be found to be the speediest solution.

Opportunity Underground

WHEN SAN FRANCISCO built a parking garage beneath one of its downtown parks in 1943 it pointed a way to traffic relief that is certain to be embraced elsewhere. Unless all signs fail, the next few years will witness a small boom in the construction of such facilities, with consequent opportunities for engineers in a new field. Evidence of interest in underground garages has been signalized recently by passage of a bill by the Massachusetts legislature authorizing construction under Boston Common; by news that Detroit has a garage designed for the quarter-mile length of Washington Boulevard; and by recent recommendations by the New York City Planning Commission that underground parking should be developed as a means of clearing that city's overburdened midtown streets. San Francisco's experience is said to indicate possible amortization of its investment in twenty years; an indication that underground garages can be self-liquidating if municipally owned or can attract investment capital if private ownership is contemplated. Neither design nor construction of underground garages should present any great difficulties, although novel and different problems will no doubt be encountered, and there will always be the necessity for devising designs and construction methods that will reduce costs. Thus, underground garages offer a new opportunity for engineers and construction men to practice their art, and additionally a chance to loosen somewhat the throttling grip that traffic congestion has clamped on the economic life of our cities.

Engineers in World Affairs

FUNDAMENTAL FACTS about engineers and the engineering profession were stated with unusual clarity by C. R. Young, dean of the Faculty of Applied Science and Engineering at the University of Toronto, in an address delivered recently to the Graduate Society of the Ecole Polytechnique at Montreal. He had this to say:

> There is need for acquisition in college of a firm understanding of those ethical principles that must guide every faithful practitioner of a learned profession. No hard and fast rules of conduct exist, but there are certain standards of faithful service to the public and to the community, standards of fairness and consideration for colleagues and for rivals. Unless the young practitioner recognizes these things, he is in no true sense a member of a learned and enlightened profession.
>
> The engineer is above all a member of society and as such it is his duty to cooperate with other men of earnestness and good faith to advance its interests, to improve the welfare of his community, to do all in his power to make this world a better place in which to live. If he ignores these obligations and confines himself to his laboratory or his office, letting the world go by, he may yet be set down as a clever technologist but not as a real engineer.

In these troubled days engineers should take these words to heart. Frequently one hears it said in engineering circles that many of the world's difficulties would be ironed out if engineers were called in to solve the problems. That may be true, but how is the world to know what engineers can do toward solution of larger problems if they do not build up widespread recognition of their ability by helping in the resolution of the many little problems that currently beset their local communities. And, of course, a first need for deserving such recognition is to live and work by those ethical standards that Dean Young properly characterizes as the necessary guide of every "faithful practitioner of a learned profession".

Federal Aid for Beaches

LOGIC has finally prevailed in resolving the question of furnishing federal aid for shore and beach erosion protection. Henceforth states, cities and other political subdivisions will be eligible for federal contributions up to one-third of the construction costs of such facilities as groins, breakwaters and seawalls.

Made possible by the President's signature on Public Law 727, the new development is the result of many years' work by the American Shore and Beach Preservation Association and other interested parties who felt that our ocean fronts and lake shores were on a par with our river banks as a national asset that deserved nationally-aided protection. Congressional refusal to so regard them lost all force when river protection work was formally recognized as flood control instead of merely an aid to navigation, first by inference in the flood control act of 1928 and then quite definitely in the act of 1938. Extension of federal aid to ocean and lake fronts is, therefore, both proper and just and in accord with established precedent.

Moreover, such a broadening of financial interest should prove a progressive step. For one thing it will bring U. S. Engineer Department experience to bear on the problem, both in construction and in the research that can be undertaken at the Vicksburg Waterways Laboratory. For another, it will permit large, integrated projects to be carried out and thus avoid the tragic waste of funds that so often follows piecemeal protective measures. Finally, the possibility of securing federal aid will encourage states and cities to plan their projects more carefully, completely and scientifically.

Many details as to the cooperative procedures that must be set up remain to be worked out, principally by the Office of the Chief of Engineers, but a real start has now been made in effective shore and beach protection. That is progress, and it is all to the good.

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Welded H-Trusses of Standard Design Aid Development of Conveyorized Layout

Contents in Brief—*The roof framing of a new General Electric Co. factory permits locating suspended loads without the usual panel point limitations. Welded steel jack trusses of 40-ft. length are used with 60-ft. trusses of similar construction to provide a maximum of unobstructed floor space. Members are composed entirely of rolled H-beams with webs vertical. Other outstanding features of the plant include semi-controlled and controlled-conditions areas, special service flooring, scrap disposal system, and treatment facilities for water used in boilers and manufacturing processes.*

SOME OF THE ADVANTAGES inherent in the H-section welded roof trusses adopted as a standard by The Austin Company have been demonstrated in the new plant built for the General Electric Co. for the manufacture of fractional horsepower motors at Tiffin, Ohio. Trusses of this type, built up entirely of rolled sections, with webs vertical, do not require the location of suspended loads at panel points. This structural feature has given layout engineers exceptional freedom in the arrangement of monorails and other overhead handling facilities, which are highly important to the attainment of efficiency demanded of special purpose plants.

The one-story, steel-frame, brick-faced building (Fig. 1), which is 376 x 632 ft. in plan, is on a site selected by the owners for its accessibility to a good labor market and the availability of rail transportation. In this plant, raw materials will be processed into record quantities of rotors and stators for household appliances by straight-line production. The layout of the structure was determined by the plant's concentration on a small number of sizes of product and the desire to obtain the fullest possible benefits of mass production techniques. This also established the need for partly and entirely controlled conditions in certain working areas, the positioning of the railroad sidings along the west side, and the location of a street on the east (Fig. 2).

Offices and employee facilities, including washrooms, locker rooms and cafeteria with clear glazed tile, are situated in the low section along the street facade, where a continuous band of projected metal sash has been installed. The facade is composed of face brick with horizontal bands of limestone trim.

Incoming materials will be unloaded at floor level directly from box cars or trucks to enclosed siding and truck docks in the large receiving department at the northwest corner of the building (Fig. 3). Here 80-ft. welded trusses give two 15-ton cranes free access to all parts of the receiving area. Around this region, insulated corrugated asbestos siding and sash are used above brick curtain walls. The reinforced concrete floor of the receiving area has a load-carrying capacity of 4,000 psf.

In the adjacent area to the east, pickling tanks, special metal cutting

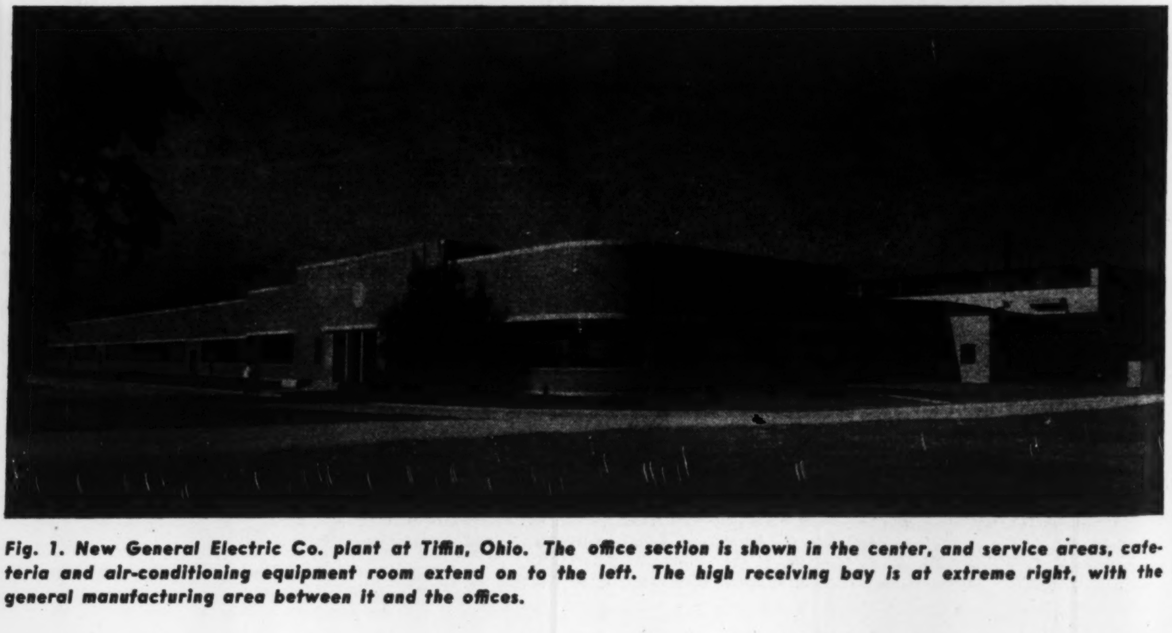


Fig. 1. New General Electric Co. plant at Tiffin, Ohio. The office section is shown in the center, and service areas, cafeteria and air-conditioning equipment room extend on to the left. The high receiving bay is at extreme right, with the general manufacturing area between it and the offices.

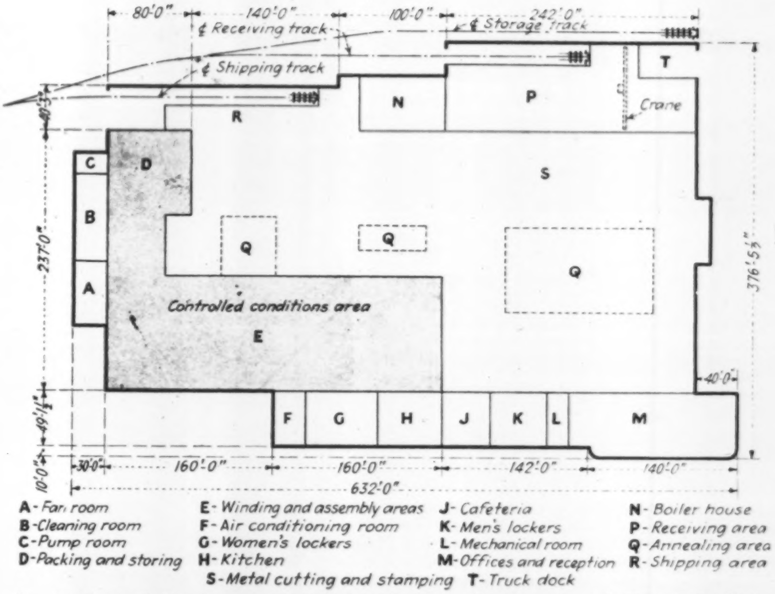

80'0"
140'0"
100'0"
242'0"
℄ Receiving track
℄ Storage track
℄ Shipping track
Crane
Controlled conditions area
A B C D E F G H J K L M N P Q R S T
237'0"
376'5½"
49'1½"
10'0"
40'0"
30'0"
160'0"
160'0"
142'0"
140'0"
632'0"
A - Fan room
B - Cleaning room
C - Pump room
D - Packing and storing
E - Winding and assembly areas
F - Air conditioning room
G - Women's lockers
H - Kitchen
J - Cafeteria
K - Men's lockers
L - Mechanical room
M - Offices and reception
N - Boiler house
P - Receiving area
Q - Annealing area
R - Shipping area
S - Metal cutting and stamping
T - Truck dock

Fig. 2. Plan of the one-story factory showing the location of the controlled-conditions section with respect to other working areas.

and stamping equipment have been installed. One of the outstanding features of this department is the ingenious under-floor system for the handling and disposal of scrap metal. All metal scrap, from blanking and repunch presses, drops through floor openings directly behind the presses into an underground trench conveyor system. The material is then transferred to an elevated belt conveyor that crosses over the 80-ft. receiving bay to a large hopper located directly above a special scrap loading spur.

The semi-controlled general manufacturing departments have special ventilating equipment that provides 22 changes of air per hour. This is accomplished by means of motor-operated roof ventilators and sheet metal hoods that trap heat produced by large batteries of annealing furnaces (Fig. 4). The ventilators are located above the furnaces and draw air from the surrounding areas past the furnaces where the temperature is held down to the comfort level at all times. Wood-block flooring has been installed throughout this portion of the plant.

The controlled-conditions areas, amounting to about 30,000 sq. ft., are located in the southeast section of the plant (Fig. 5). Having a strip maple floor and flash tile walls, this region includes a winding and assembly area and the packing department, where motor elements are wrapped after they emerge from the cleaning room enroute to the shipping platform.

Roof construction

The building has a light-gage steel roof deck with 1-in. cane-fiber insulating board in the general areas and 1½-in. in the air-conditioned section. The entire roof is covered with a 20-year bonded waterproofing.

Column spacing of 40 x 60 ft. has been maintained throughout the production department, where 60-ft. standard welded roof trusses, as developed by The Austin Company, have been used (Fig. 7). Alternate trusses are supported by 40-ft. jack trusses of the same design (Fig. 8). Assembled without gusset plates, they are composed entirely of rolled H-beams which are merely cut to length and welded. Trusses of this type up to 80-ft. span have been tested. (*ENR* Jan. 25, 1945, vol. p. 122; June 28, 1945, vol. p. 882; and July 4, 1946, vol. p. 15.)

In fabrication, at the Austin structural shop, the H-beams were assembled in a jig and tack-welded. Welding was completed with the truss in a vertical position, after which the welds were subjected to rigorous inspection. The trusses could have been adapted to different loads by simply changing the weights of the beams. If the depths of the individual members are kept constant, these variations require no changes in shop details or fabricating jigs.

Thus, through standardization on a type of truss which will accommodate a wide range of loadings, considerable saving in engineering and detailing expense has been effected. At the same time, the basis has been laid for application of mass produc-

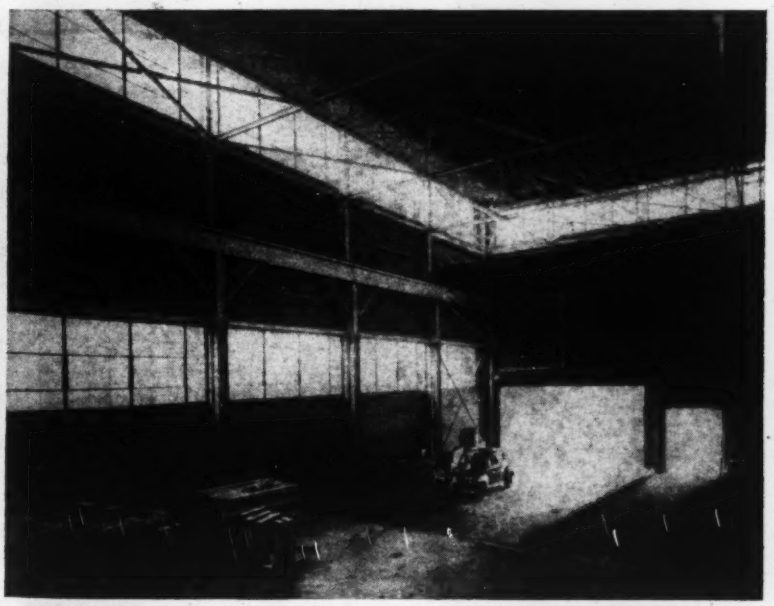


Fig. 3. The receiving bay has insulated corrugated asbestos siding, brick curtain walls and a light-gage steel roof deck supported on 80-ft. welded trusses. Two 15-ton cranes operate in this area.

tion methods in the structural shop, where a substantial increase in efficiency has resulted.

The inherent stiffness of the trusses has been an important factor in speeding field erection, and the double flanges of H-beams in top and bottom chords have proved a special asset. Iron workers have commented favorably on the superior footing and "seat" which make it easier and safer to work and get around on the trusses.

While original specifications called for the welding of all field connections, a shortage of welders in the vicinity made it necessary to rivet truss connections at the columns so that the only welded truss connections were those connecting alternate 60-ft. trusses to the jack trusses.

Provision for conveyors

Roller and belt conveyor systems perform the heaviest materials-handling functions in the Tiffin plant, but monorail bridge cranes and hoists have been suspended from the trusses in almost every department, either for the handling of incoming raw materials or in connection with the interdepartmental handling of materials in process. In the controlled-conditions winding room, for instance, continuous belt conveyors at table height are supplemented by a network of monorails which are used for transporting completed work to the cleaning and shipping departments.

To insure adequate foundation support, structural members are carried on concrete caissons. These were formed by drilling a 3-ft.-diameter hole into the hardpan, usually found about 8 or 9 ft. below the surface of the ground. Then, the bottom of the hole was belled out to 5-ft. diameter, dowels placed and the opening filled with concrete.

In the interests of flexibility, all power distribution, compressed air, water, gas and other service lines are carried overhead through the trusses. About 2,500 ft. of 400-amp. three-phase bus duct is used to distribute power throughout the plant. A three-conductor interlocking armored cable connects bus duct and furnaces with the three 2,000-kva. double-ended, load-center substations, each of which is connected to the primary switchgear with 5,000-v. interlocking armored cable. The primary switchgear

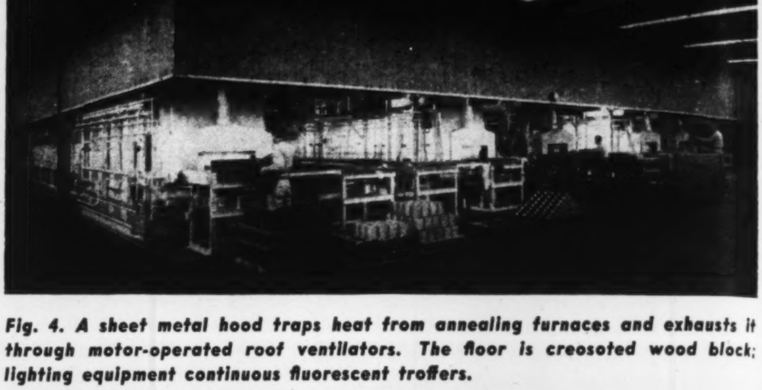


Fig. 4. A sheet metal hood traps heat from annealing furnaces and exhausts it through motor-operated roof ventilators. The floor is creosoted wood block; lighting equipment continuous fluorescent troffers.

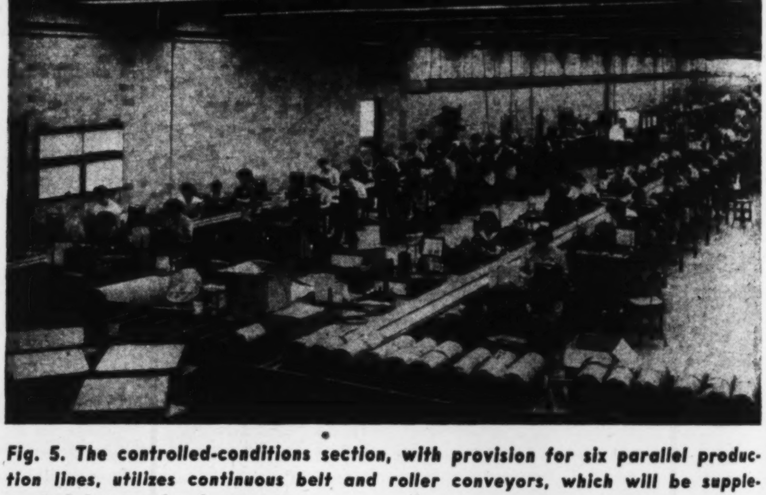


Fig. 5. The controlled-conditions section, with provision for six parallel production lines, utilizes continuous belt and roller conveyors, which will be supplemented by overhead conveyors.

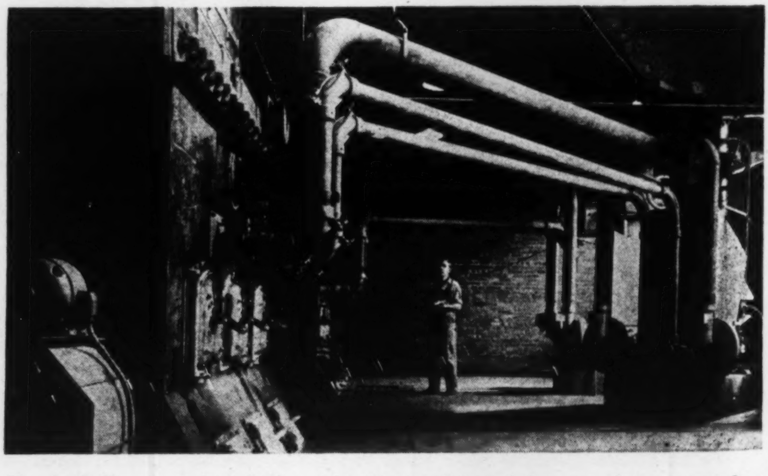


Fig. 6. Boiler room installations include two integral furnace steam generators each designed for continuous generation of 15,000 lb. per hour of saturated steam at 130 psi.; a 200-ton capacity steel coal bunker with gravity feed to spreader stokers; and a steam-operated pneumatic-type ash removal system.

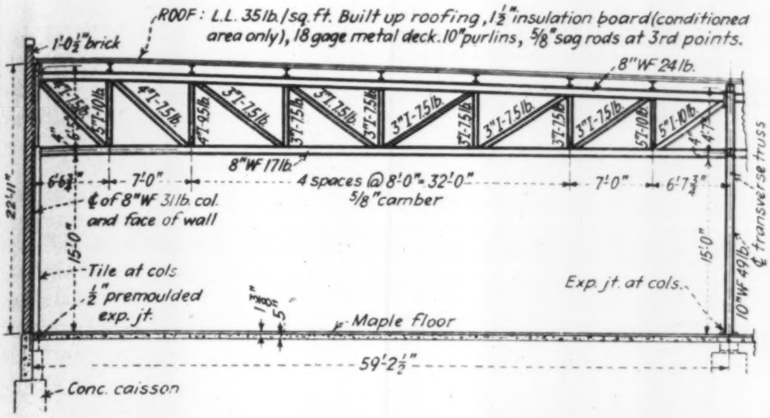

ROOF: L.L. 35 lb./sq. ft. Built up roofing, 1½" insulation board (conditioned area only), 18 gage metal deck. 10" purlins, ⅝" sag rods at 3rd points.
1'-0½" brick
8" WF 24 lb.
5"I-7.5 lb.
5"I-10 lb.
4"I-7.5 lb.
4"I-9.5 lb.
3"I-7.5 lb.
5"I-10 lb.
8" WF 17 lb.
6'-6¾"
7'-0"
4 spaces @ 8'-0" = 32'-0"
7'-0"
6'-7¾"
⅝" camber
℄ of 8" WF 31 lb. col. and face of wall
22'-11"
15'-0"
Tile at cols
½" premoulded exp. jt.
Maple Floor
Exp. jt. at cols.
15'-0"
10" WF 49 lb.
℄ transverse truss
59'-2½"
Conc. caisson

Fig. 7. Part section of the building shows typical standard 60-ft. welded truss composed of rolled beams with webs vertical.

receives 4,160-v. power from a three-unit 69-kv., 5,000-kw. substation through lead-covered cables installed in duct lines underground. Batteries furnish power for main outdoor substations and also provide emergency lighting for the plant.

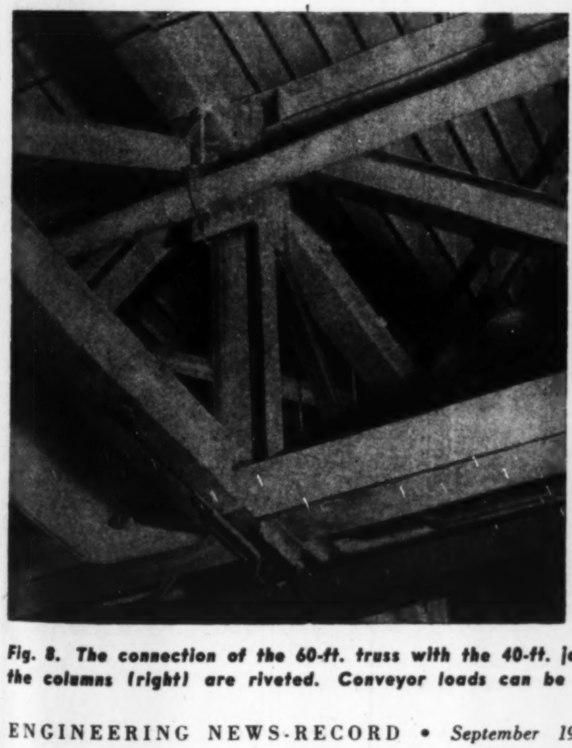
Operating on 265 v. and two-lamp ballast, the lighting equipment in the factory will consist of 1,705 two-lamp (100-watt) fluorescent fixtures. The lights are regulated by push-buttons controlling magnetic contactors connected to the 265/480-v. three-phase four-wire distribution system. The illumination level is about 45 foot-candles, with fixtures mounted in continuous rows on 13-ft. 4-in. centers, 14 ft. above the floor.

The controlled-conditions area in the factory is divided into several sections. It requires a refrigerating capacity of 200 tons. About six air changes per hour will provide average comfort conditions in the winding room, while the special storage room calls for control at 80 deg. F. and 50 percent humidity the year round. Air from this area is exhausted into the adjacent manufacturing departments. Air conditioning in the office area was not installed for the present, but it was regarded as necessary for the core-winding room, where a large number of employees are to work in a relatively confined area.

Water is obtained from wells and an adjacent river and consequently is subject to wide variation in quality. It is treated for use in air conditioning condensers, for makeup for the power-plant boilers, and for cooling furnaces and other process equipment for which it is cooled from 180 deg. F. to 90 deg. F.

The treatment plant located remotely from the boiler house, across the siding to the west of the main building, houses a system designed for the particular water available and for the use-purposes of the plant process and the boiler plant. Included in the water treatment equipment are carbonaceous zeolite softeners for primary treatment. Water from these softeners goes in part to the boiler feed-water heater, and in part through an acid-treating plant designed to further condition the water for the plant process uses. This treatment includes dilute acid injection, degasifying, and further controlled caustic and acid mixing for the obtaining and maintenance of the desired pH value required in the plant process.

The project was designed and built by The Austin Company, Cleveland, Ohio. H. J. Sprackling was construction superintendent. Al Childs represented General Electric Co.



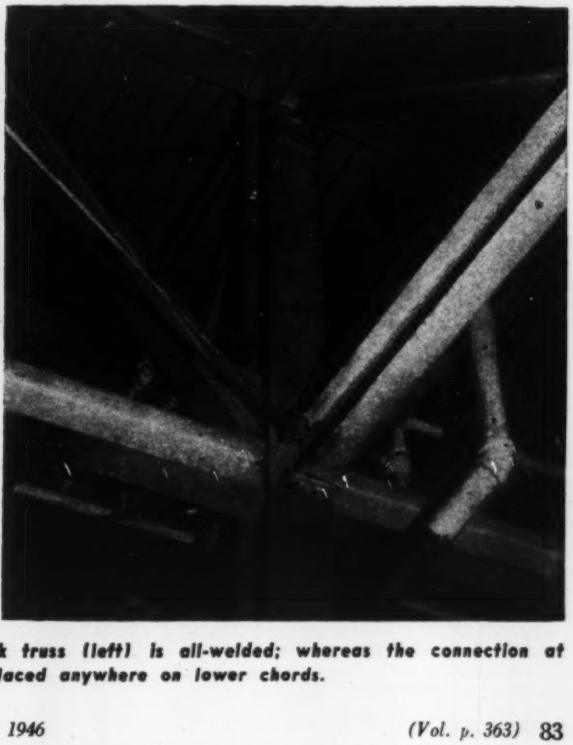


Fig. 8. The connection of the 60-ft. truss with the 40-ft. jack truss (left) is all-welded; whereas the connection at the columns (right) are riveted. Conveyor loads can be placed anywhere on lower chords.

Concrete Connectors for Timber Joints Found Successful Under Test

Max Miller
Philadelphia 5, Pa.

CONNECTORS FOR TIMBER joints made from cement mortar forced into prepared pockets after the wood members are assembled have proven successful under extensive tests. Such connections have several advantages: (1) full contact bearing is obtained against all wood areas, (2) misalignment of fabricated pockets causes no assembly difficulty and does not affect the strength, (3) shrinkage or misshaping of connector pockets has no harmful effect, (4) timbers can be dismantled and reassembled with dependable joints despite injuries to connector pockets.

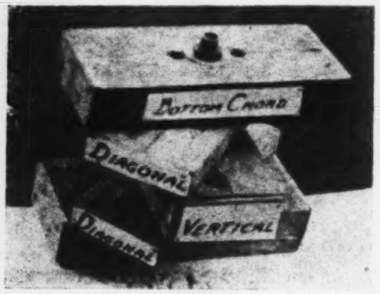


Fig. 1. Five member assembly of typical truss joint. Note mortar entry end of pipe bolt and final overflow holes.

Plastic mortar forms connectors

The concrete connectors are of the solid-dowel type and are made by forcing plastic mortar into blind connector pockets existing at the contact faces of the timbers after they are permanently clamped in final position. The clamping bolt is a ¾-in. pipe, which is used to carry the mortar to the end connector of a group. All other connector pockets are filled by consecutive overflow of mortar through two flow holes between successive pockets until the last pocket to be filled overflows to the face of the outer timber of the joint assembly, thus indicating that all connector pockets are full.

Holes in the timbers for the concrete connectors need not be circular and may be any suitable shape. Under conditions precluding use of power and special tools, the connector pockets can be cut by simple hand tools.

A series of tests on 40 full-sized connectored assemblies was made in the material testing laboratory at George Washington University to determine the value of the connectors in joints with members at 45 degree and 90 degree angles as well as parallel to the wood grain.

Connector sizes

Tests were designed to give results that might parallel the average capacity values of the commonly used steel ring connectors. The mortar connectors were made 3 in. dia. by 1 in. thick, 4½ in. by 1 in., and 4½ in. by 1¼ in. The first two sizes have practically the same overall dimensions as the nominal 2½ and 4 in. dia. split-ring connectors. Concrete connectors were made square as well as round to explore possible improved capacity of the square shape with its nearly flat bearing surface. All load tests were made 14 days after filling the mortar connectors.

Test results favorable

Clamping bolts used were ¾-in. extra-heavy pipe nipples with malleable iron lock-nuts. Mortar was made from equal parts of sand and high-early-strength cement. It developed a strength of 10,500 psi. at expiration of 15 days.

Concerning the tests, the official laboratory report states: "Filling of the connector pockets is definite and yields a sound joint. The proportional limits indicate permissible loads comparable to those listed for split-ring connectors of approximately the same size in directive No. 29 of the War Production Board.

"There was no visible evidence that introduction of the moist connector mortar into the bodies of the wood specimens affected them. In all cases, failure came from crushing and shearing of the wood. In no case was there any sign of crushing or shearing of the mortar connector in the zone of high-pressure application. The two specimens loaded to 24,000 lb. and then dismantled showed the connectors in perfect condition. In the case of the 36 specimens loaded to ½-in. and ¼-in. slip, some connectors showed hair cracks radiating from the central clamping bolt. Accompanying the ½ in. vertical slips, horizontal spread of wood members was barely apparent."

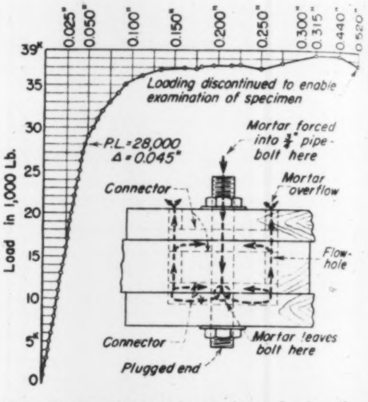


Fig. 2. Load test in end grain loading of two 1⅝ x 7⅝ and one 2⅝ x 7⅝-in. pieces of southern long leaf yellow pine with 14-day old, 4½ in. dia. concrete connectors.

The concrete connectors were developed and patented by the author. Tests were made under sponsorship of the War Production Board at Washington.

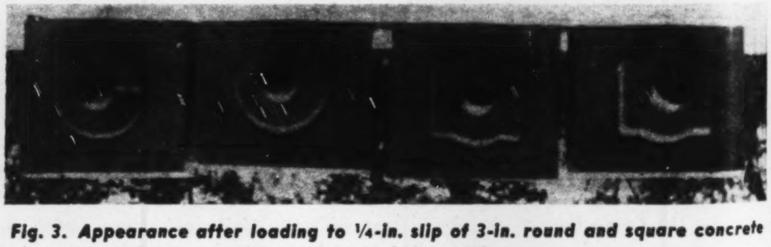


Fig. 3. Appearance after loading to ¼-in. slip of 3-in. round and square concrete connectors. Some connectors showed hair cracks.

Ten-Year Program for Wyoming Airports

Contents in Brief*—Governor Lester C. Hunt and the Wyoming Aeronautics Commission, aiming at speedily finding a program that would win unanimous support, retained an engineering firm to develop a statewide airport system. Simple, speedy methods were used in compiling a comprehensive report.

REALIZING THE NEED in the state of Wyoming for a comprehensive 10-year airport program to take full advantage of federal aid, the Governor and the Aeronautics Commission retained Kaiser Engineers, Inc., Oakland, Calif., to develop a program for constructing a statewide airport system.

Decision to put the project in the hands of a private engineering firm sprang from the desire to obtain conclusions and recommendations free from bias or from any political influence and based on sound engineering practice. The result has been development of a comprehensive plan fully set forth in a report which Wyoming officials believe will stimulate and guide progress in that state.

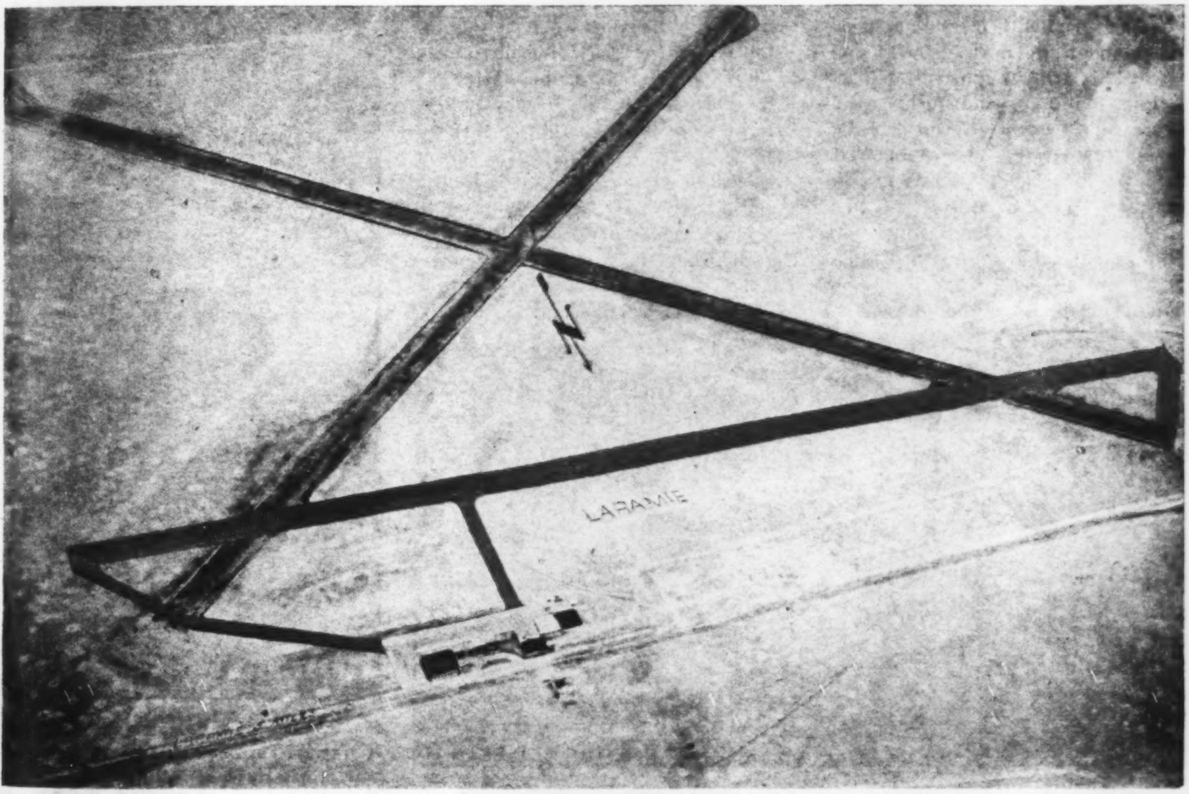
Major air routes determined

The first move was to determine which air routes through the state would best meet present and future requirements. In reaching this decision all economic factors were examined from a transportation viewpoint.

Proposed airports were then divided into three classifications: Major airports, feeder line airports and small airports. Recommended expenditure of funds for airport development was correspondingly classified into three groups. Priority 1 was allotted to immediate construction requirements; Priority 2 was placed on completing construction to meet requirements for the next three to five years; and Priority 3 was given to work to be done up to and including ten years hence.

In examining each airport site, these three classifications were used in rating the facilities required. At each site, attention was given to suitability of location, terrain, type of soil, drainage requirements, lengths of runways, and layout of runways in accordance with the wind rose and adaptability to expansion.

Part of the examination was a study of the site from the air to determine if the location met the requirements of the Civil Aeronautics Administration as to glide angles and obstructions. Not



Aerial photograph of one of the Wyoming sites on which proposed improvements have been sketched to indicate finished appearance of the airport after the new work has been completed.

until a proposed site met all the requirements was it recommended. If all requirements were met, type of construction was selected and cost estimates were compiled, taking into consideration soil analyses, weather, elevation and type of equipment to be used.

When a site did not meet the requirements, a new location was selected and new recommendations and cost estimates were worked up. In each case an aerial photograph was made of the site so that proposed improvements could be sketched in and the photograph included in the final report to convey a clear idea of what the project included. Aerial photography was used extensively in lieu of topographic maps.

In the final report, the first few pages present a summary, conclusions and recommendations and a chart showing cost estimates for each airport, broken down as to required facilities under first, second, and third priorities. Then follows more detailed attention to each airport with one full page showing the aerial photograph with improvements sketched in, opposite a page setting forth recommendations for improvements, estimates of cost on each facility and full justification for expenditure of funds.

An aid to national planning

Taken as a whole, the finished report is a comprehensive 10-year program for the state of Wyoming that will fit into and become part of the national airway system and at the same time will provide for expansion during the next decade at least. This procedure not only puts into the hands of Wyoming's Aeronautics Commission an accurate basis for planning its own construction program with the aid of federal funds but also furnishes the CAA with complete detailed information needed in developing that part of the national airport program.

The consultant in charge of the airport division of Kaiser Engineers, Inc. is F. D. Gore, who was formerly chief of the engineering section of the Army Air Corps Headquarters during its wartime expansion program. In that capacity he was responsible for the location, design and supervision of construction at a number of the Army's major air bases.

Sampler for Hard-to-Hold Soils

A NEW TYPE of soils sampler first used by the U. S. Army Engineers on the construction of Denison Dam on the Red River is finding wide application. Developed originally for sampling cohesionless soils, the device is now being used by the Army Engineers at many locations to obtain undisturbed samples of all types of overburden materials except gravel. These materials include soft shales, marly clays, siltstone, soft friable sandstone, hardpan or other types of material that are susceptible of being washed or ground away when cored or sampled by conventional methods. The Bureau of Reclamation has also used the sampler on several damsite investigations, as illustrated by the accompanying pictures.

Known as the Denison sampler because of the location where it was developed and first used, the instrument is of the 6-in. dia. double-barrel design illustrated by the accompanying drawing. The inner barrel is suspended from the head of the sampler by means of a ball-bearing swivel and is free to turn independently of the outer barrel. The inner barrel is fitted with a cutting shoe, a steel spring sample catcher, and a removable 6 x 24-in., 28-gage sheet metal sleeve.

The inner bit and catcher serve to cut and retain a sample of the soil being investigated. The outer barrel is fitted with a shoe carrying several cut-

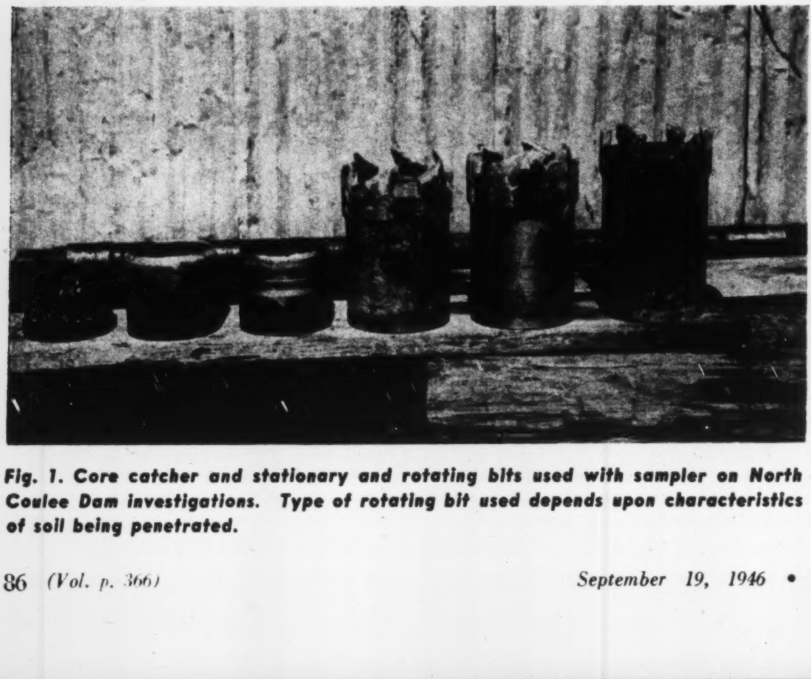


Fig. 1. Core catcher and stationary and rotating bits used with sampler on North Coulee Dam investigations. Type of rotating bit used depends upon characteristics of soil being penetrated.

Fig. 2. Removal of sample tube after the instrument has been withdrawn from the hole is quickly accomplished. Tool used for this purpose at North Grand Coulee work is illustrated, but other designs are available.

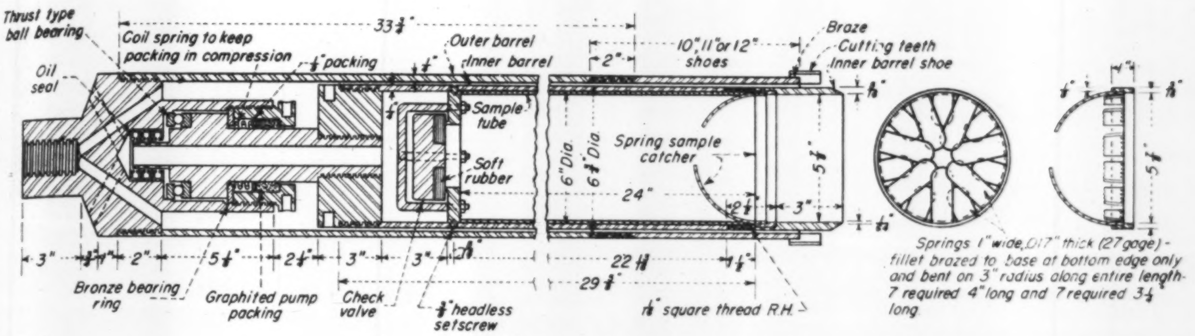

Thrust type ball bearing
Coil spring to keep packing in compression
33 1/2"
Oil seal
1/4" packing
1/4"
Outer barrel
Inner barrel
Sample tube
Soft rubber
6"Dia.
6 3/4"Dia.
2"
10", 11" or 12" shoes
Braze
Cutting teeth
Inner barrel shoe
Spring sample catcher
24"
2 1/4
3"
5 3/4"
1/16"
1"
3"
2"
5 1/4"
2 1/4"
3"
3"
22 13/16
1 1/4"
29 3/4"
Bronze bearing ring
Graphited pump packing
Check valve
3/8" headless setscrew
5/16" square thread R.H.
Springs 1" wide, .017" thick (27 gage) - fillet brazed to base at bottom edge only and bent on 3" radius along entire length - 7 required 4" long and 7 required 3 1/2" long

Fig. 3. The sampler is of double-barrel design with the inner barrel free to move independently of the outer barrel. Length of the outer cutting shoe and design of the teeth are varied to meet field conditions.

ting teeth which loosen the material just outside and above the inner cutting shoe, reducing the resistance to its being penetrated. The relative position of the cutting teeth with respect to the inner bit, and the shape and number of the cutting teeth may be varied to meet changing field conditions.

A recent development resulting in lower costs is the use of ordinary stove pipe with uncrimped ends in lieu of 28-gage galvanized sheet metal sample tubes. The stove pipe costs 4 or 5c. per 2-ft. length, whereas, each galvanized sample tube costs 25c. However, the use of stove pipe is practicable only in sampling materials free from gravel and rock fragments and when samples are to be opened and tested within a week or two. If samples are to be kept for any length of time, galvanized sample tubes should be used.

Bit driven with rotary rig

The bit is driven by a standard diamond drill machine or a light rotary drill rig, preferably equipped with a hydraulic feed. For the work by the Bureau of Reclamation on the North Grand Coulee damsite, which is illustrated by the accompanying pictures, the Denison sampler and the hydraulic feed were constructed in the Coulee Dam machine shops. Both the feed and the sampler were designed for use with 3-in. double-strength pipe. The use of the heavy pipe for drill rod eliminated a large amount of whip by the sampler, especially on the deeper holes. The U. S. Army Engineers employ standard equipment using "N" type drill rods.

The hydraulic feed rotates the outer cutting bit, at the same time jacking the inner bit into the formation being sampled. The rotating speed and the forward progress of the sampler must be adjusted to the material. Friction between the soil core and the inner sample barrel keeps the inner barrel from rotating. During the drilling operations, drill mud is pumped down the drill pipe for discharge through the space between the inner and outer bits. The drill mud serves to remove the cuttings loosened by the outer cutting bit and to support the walls of the drill hole.

The first sampler of the Denison type was designed by H. L. Johnson, who at the time was serving as foundation engineer for the U. S. Army Engineers on Denison Dam and is now division geologist and foundation engineer in the Southwestern Division office, U. S. Army Engineers.

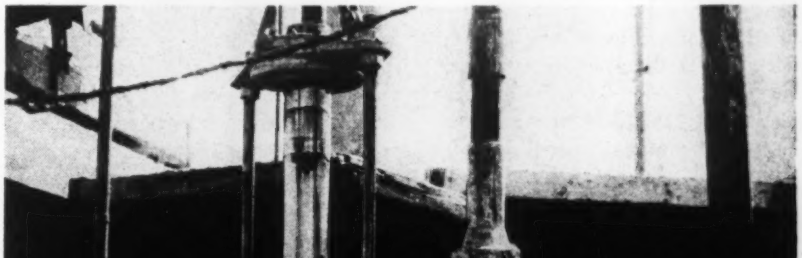


Fig. 4. In using the sampler, which the workman is touching with his left hand, at the North Coulee damsite, double-strength 3-in. dia. pipe was employed to reduce "whip". The hydraulic feed of the drill used to handle the bit is shown at left.

Modified Bailey Bridge Trusses Provide Temporary River Crossing

G. H. Allen
Contractor and Engineer
Vincennes, Ind.

***Contents in Brief**—Eight lines of Bailey bridge trusses were assembled on shore in two sections, swung into position with a shore-based guy derrick and decked with timber to provide a 100-ft. span, two-lane highway bridge over the Patoka River in southwestern Indiana. The bridge was completed in 48 days to serve as a temporary crossing, following the collapse of a 68-year old pin-connected truss bridge.*

WARTIME predictions that the Bailey military bridge would find useful application as an emergency peacetime structure were borne out in one instance recently when eight 110-ft. trusses were erected to form a temporary highway bridge over the Patoka River at Jasper, Ind. Of significant importance is the fact that the completed span cost very little more than the estimated cost of a conventional timber deck and pile bridge, yet it furnished a 100-ft. clear opening free from ice jams and driftwood. Also, the Bailey bridge trusses required little erection equipment, and the job was completed in a relatively short time without interference from high water.

The two-lane highway bridge, carrying a timber deck on Bailey trusses, was completed in 48 days after a contract for its construction was awarded by the State Highway Commission of Indiana. It replaced a 120-ft. pin connected truss span erected in 1878, which collapsed on Dec. 5, 1945, when a skidding truck knocked one of the bearing shoes off one of the abutments. The old span had been posted for a six-ton load for several years.

The situation was immediately classified as an emergency since the old structure had furnished access to Jasper for two state highways as well as to a large suburban area from which people could walk to town. In view of the emergency, the highway department quickly installed a pontoon foot bridge across the river, and began surveys and plans for a temporary structure. Bids were received on Jan. 3 for a wood-pile bent bridge similar to the state's standard run-around, or detour, structures.

Alternate type bridge permitted

The proposal for bids permitted an alternate lump-sum item for any alternate scheme that a contractor wished to submit. Several months prior to the letting the writer had purchased some Bailey bridge panels, pins and braceframes as government-owned surplus material. Consequently, an alternate bid was submitted using this material and based on the writer's design for a clear span opening of 100 ft. Although this alternate bid was $300 higher than the low bid submitted for a pile bent bridge, the writer was given the contract as the single clear span eliminated trouble from ice and drift resulting from the use of several pile bents in the river.

The contract was awarded Jan. 11 with a stipulation that the contractor work Sundays and holidays, and complete the bridge before March 1. The contract also required the removal of the old span from the river.

Erected by derrick on shore

Several methods were considered for erecting the temporary bridge and it was finally decided that one which could proceed during high water would be the best. A 20-ton guy derrick with 85-ft. mast and 75-ft. boom was rented, and using this, no other erection equipment was needed for the job except a derrick the writer built on an old flat bed truck. The guy derrick when set near the edge of one abutment quickly removed the old trusses from the river and landed them on adjacent high ground.

In order to expedite the completion work was started four days before the contract was officially awarded. The truck derrick was used to remove the old steel adjacent to the abutments and to erect a gin pole for raising the derrick mast.

The clear distance between abutments was 113 ft., while the Bailey truss panels are in multiples of 10 ft. Consequently, a bent was constructed 4 ft. from the south abutment to support one end of the new bridge. (For details of Bailey bridge trusses see *ENR*, July 26, 1945, vol. p. 118). Steel from the old bridge was used to make this bent which consisted of I-beam posts concreted in rock, with a chord section for a cap.

A second bent was placed 14 ft. from the south abutment to provide a clear span of 100 ft. However, it could not be placed at the start of the job because of high water. Part of the old stone masonry forming the bridge seat of the north abutment was removed to a depth of 6 ft. to provide a bearing for the trusses and to accommodate the new deck-type bridge, without disturbing the approach grade.

Trusses assembled on skids

All miscellaneous work was completed when the guy derrick, together with an electric hoist, arrived on the job January 23. While the derrick was removing the old bridge from the river six men started assembling the Bailey truss panels on timber skids laid on the adjacent highway. The bridge was assembled and erected in two sections, each section containing four 110-ft. trusses spaced 2 ft. 8 in. apart. The spacing of trusses was governed by the allowable clear span of the 4-in. flooring in the timber deck.

Panels in the adjacent trusses were held in correct position by timber blocks nailed to the skids and wood spacers at the top, with diagonal braces to the ground to hold them vertical. Vertical cross-bracing was welded between trusses at one end of each 10-ft. panel. Horizontal cross-bracing also was welded in both top and bottom chord planes in each panel. The resulting assembly was a box girder consisting of four Bailey trusses 110 ft. long and 8 ft. wide.

Truss assemblies weighed 14 tons

After the first half of the bridge was assembled it was set in place and the second half was assembled and welded on the same skids. Each section weighed about 14 tons and the center of the load when in final position was slightly over 60 ft. from the derrick mast. This bulky load required careful handling and was moved slowly at all times. A wire rope tag line connected to a two-man hand winch was placed across the river so that the swinging of the load always would be under control.

While the trusses were being set, there was a camber of about 2 in. at the center and after they were set in position there was a sag of 3¼ in. Although the pins that connect the panels were made for a driving fit there was enough play in the ten joints of each truss to cause this deflection. The addition of a timber deck increased this dead load deflection to 4¾ in. for the 110-ft. span.

Timber deck has 20-ft. roadway

After both truss assemblies were set on the substructure, I-beam struts were welded to connect the two assemblies at the bottom chord panel points. A 4-in. native timber floor, using 4x8-in. planks laid flat, was then bolted to the top chord of each truss. Splices in the flooring were alternated at the two center trusses, and plate washers were used at the bottom of the top chord section of each truss so it would not be necessary to drill holes in the truss members and reduce their strength.

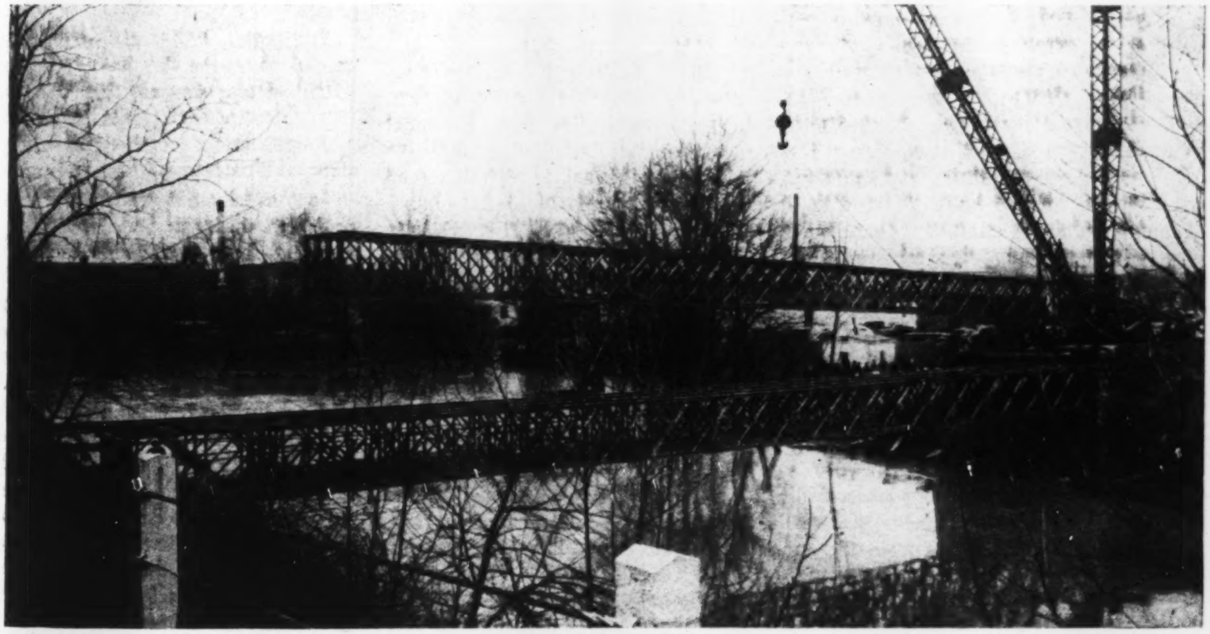
A 2-in. timber floor was placed longitudinally over the 4-in. transverse flooring to give a smooth riding surface. Wood curbs of 6x8-in. timbers were bolted to the floor to provide a 20-ft. clear roadway, while a timber handrail was placed on each side, bolted to the curb and braced to the floor boards that had been extended at 10-ft. intervals.

Following completion of the superstructure the additional bent located 14 ft. in front of the south abutment was constructed as the water in the river had subsided to permit placing the concrete footing. This bent was fitted snugly under the trusses but no attempt was made to jack up the existing deflection at that point. I-beam stringers were used to carry the floor to the south abutment across the 4-ft. gap from the first bent.

Traffic was routed across the bridge February 28, one day ahead of the original completion date and 18 days ahead of the extended completion date which took into account unsuitable weather. Observations of deflection were taken for several days after the bridge was opened and 7-ton loads caused a live load deflection of ½ in. It is planned to dismantle this structure when the new bridge, which is now being planned, is completed on an adjacent location.

Engineering personnel

Personnel of the highway commission who supervised the work were Fred Kellam, engineer of bridges (now division bridge engineer, Chicago office, Public Roads Administration); W. W. Hadley, engineer of bridge construction; Russell Cooper, assistant engineer of bridge construction (now bridge engineer); J. P. Thomas, district engineer of bridges, Vincennes District; and R. A. Robinson, project engineer. The contract was held by the writer who handled the supervision of the job.



Bailey bridge trusses assembled in two groups of four trusses each and weighing 14 tons are set by a guy derrick to form a temporary highway bridge in Indiana.

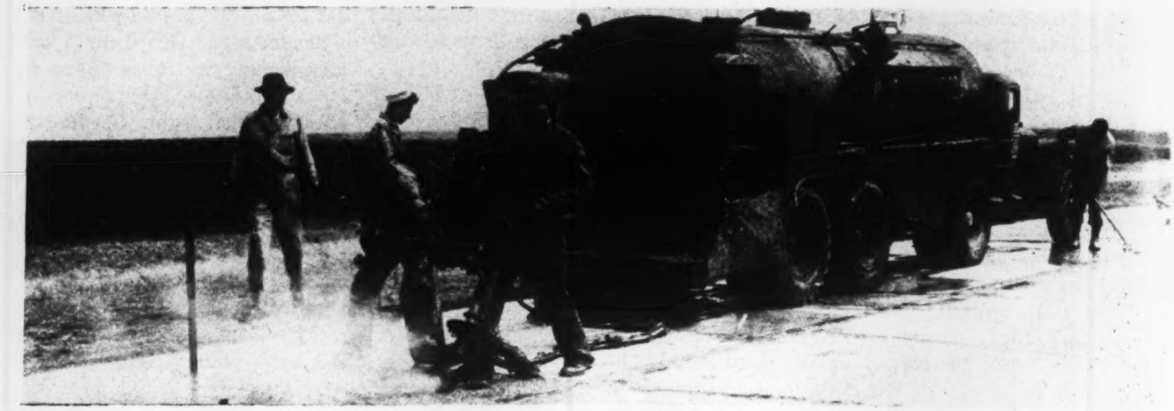


Fig. 1. As soon as the slab comes up to grade, asphalt is shut off from the nozzle by a three-way valve, and the nozzle is removed from the drilled hole. Man at left of the nozzle is ready to insert a wooden plug in the hole in the pavement.

Asphalt Underseal Corrects Pavement Pumping Through Joints and Cracks

Contents in Brief—*Asphalt underseal has been extensively and successfully used in Texas to fill subgrade cavities, raise settled slabs and stop subgrade pumping through joints and cracks in concrete pavement. Increasing proficiency in application of the process has resulted in lower bid prices as work has been let to contract, and use of high-melting-point asphalt has improved the underseal and eliminated hot-weather bleeding.*

PROPERLY APPLIED, asphalt underseal has proved effective in stopping subgrade pumping through joints and cracks in concrete pavement in the Dallas District of the Texas State Highway Department. When asphalt of the proper grade is injected at prescribed temperature and pressure through drilled holes in the slab, it fills subgrade cavities, raises settled pavement, and seals cracks and joints from below to prevent intrustion of moisture.

Neither the State Highway Department nor the district regards asphalt underseal as a cure-all for subgrade troubles in concrete pavement maintenance, but application of the process has been sufficiently extensive to warrant a conclusion that it is decidedly superior to previous methods of sealing cracks and joints from the surface and of raising slabs by mudjacking with soil-cement slurry.

In the last 15 months, the Dallas District has undersealed 57 miles of concrete pavement by contract. The work was divided among four contracts, ranging from about $3,000 to $47,000 in value. Prices have progressively declined as contractors became more familiar with the process. Cost of undersealing 20-ft. pavement has averaged less than $2,500 per mile for 19,000 gal. of asphalt placed through a total of 1,400 holes.

Table I shows how bid prices have decreased. As an indication of the cost reduction obtained through experience, it is interesting to note that the low bids quoted on the last three jobs in the table were by the same contractor, Wallace & Bowden, of Dallas.

Undersealing procedure

Undersealing is performed on one lane at a time on two-lane pavement, leaving the second lane clear for traffic. No regular pattern is followed in drilling holes, the holes being spotted at points that the engineer in charge thinks will give the best results. It is common practice, however, to drill three 1½ in. dia. holes per lane 18 in. from each transverse joint in a lane that is being undersealed.

A hole is drilled at the center of the line on the side from which traffic approaches the joint, and on the other side holes are put down about 24 in. from the pavement edge and 18 in. from the roadway center line, respectively.

Additional holes are drilled as needed where the slab has cracked or settled. Holes also are drilled 12 in. from the pavement center line where a longitudinal center joint shows signs of distress.

To inject the hot asphalt under the pavement, a special 1-in. tapered nozzle (Fig. 3) is driven into each hole by several blows with a hand hammer. The nozzle is connected by two 1-in. metallic hose lines to a pressure distributor, one hose being attached to the pump, the other to the distributor tank. A three-way valve on the nozzle unit permits the asphalt to be circulated through the hose circuit to the tank when the nozzle is not being used for injection, thus keeping the material from freezing in the line. A metal frame added around the nozzle shown in Fig. 3 prevents breakage of hose lines near the connections.

Use of pressure distributors for asphalt injection has increased the speed

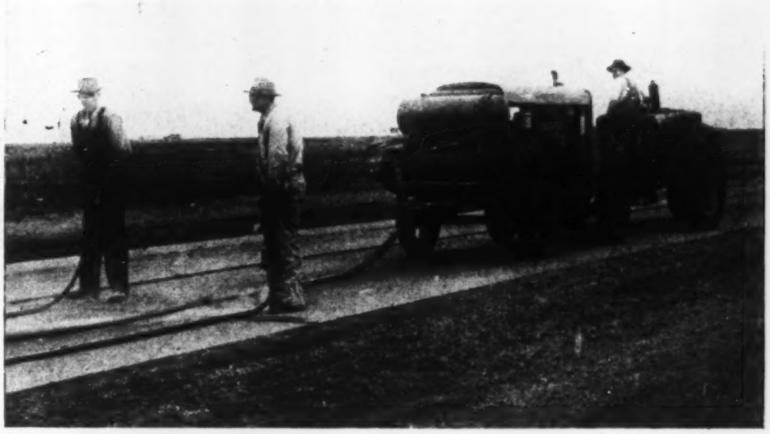


Fig. 2. Two pneumatic drills operated from portable compressor cut 1½-in. holes through concrete slab for injection of asphalt underseal. Work is confined to one lane at a time, leaving second lane open for passing traffic.

and economy of the operation. With three distributors hauling to two undersealing crews, a contractor can unload a 10,000-gal. tank car a day. The maximum quantity placed to date by two undersealing crews in a 10-hr. day is 17,000 gal. In general, asphalt injected per mile of pavement has ranged from about 15,000 to 35,000 gal. Table II gives the quantity placed and the number of holes drilled per mile in the projects completed under the four contracts. The average amount placed per hole has been 13.6 gal. More is used on the first lane undersealed than on the second.

In typical 9-6-9-in. pavement so far undersealed, two pneumatic hammer drills supplied with air from a portable compressor can cut holes for two undersealing crews. A crew for undersealing consists of a total of nine men: a foreman, a nozzle man, a helper to drive stake plugs in sealed holes, one man mopping pavement to wet it before the asphalt is injected, two men filling sealed holes with stone and cleaning pavement of excess asphalt, and a flagman. Two drillers, a compressor operator and a flagman make up the drilling crew. In addition the contractor employs operators for distributor trucks and for the tank car heater.

Blown asphalt used

By specifying hard, high-melting-point asphalt, free of volatiles, the district engineers have eliminated hot-weather bleeding occasionally encountered on their first experimental work, performed with district forces in 1944. Present specifications call for a 30-penetration asphalt with a melting point of not less than 185 deg. F. The district uses a blown asphalt from which all volatiles have been removed at the refinery. Refiners like to make this asphalt because it permits capture of more byproducts.

For unloading from tank cars, the material must be heated to 300 deg. Contractors find two heaters better than one to speed unloading. In tapping a fresh car, a distributor holding half a tankful or more of hot asphalt is hooked up to the car, with burners going, to help melt the cold material.

Temperature of the asphalt when injected under the pavement is 400 to 500 deg. F., the average being about 450 deg. To avoid generating excessive steam as the high-temperature asphalt strikes the moisture in the subgrade, thus raising the slab too quickly, the pumping pressure is limited to 35 psi. This pressure has proved effective for raising settled slab at a controlled rate.

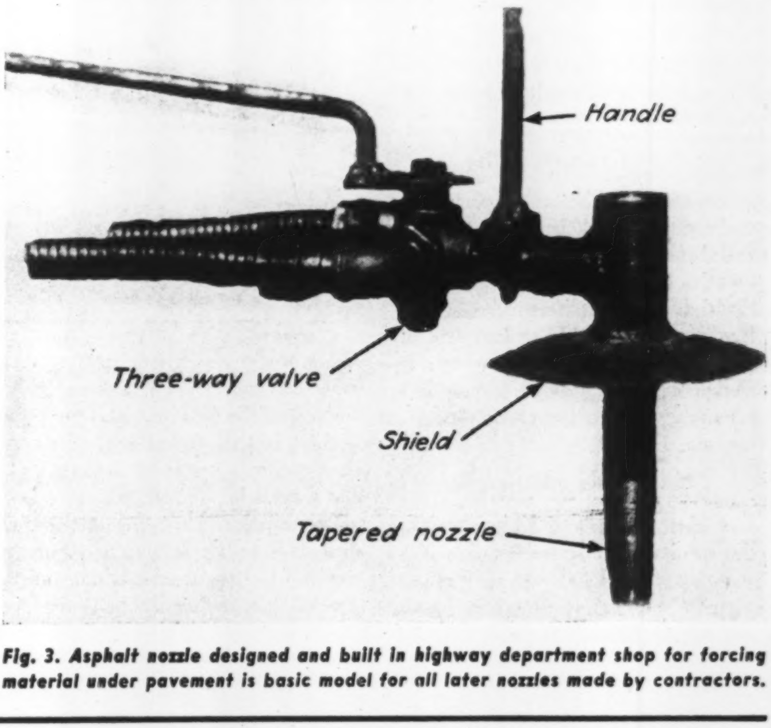


Fig. 3. Asphalt nozzle designed and built in highway department shop for forcing material under pavement is basic model for all later nozzles made by contractors.

TABLE I—BID PRICES FOR ASPHALT UNDERSEAL, TEXAS STATE HIGHWAY DEPARTMENT, DALLAS DISTRICT

Date	Length, Miles	Quantity		Unit price		Amount		Total for lowest bid
		Asphalt, gal.	Holes	Asphalt, gal.	Holes ea.	Asphalt	Holes	
Apr. 12, 1945	4.0	20,000	800	$0.144	$0.33	$2,880	$264	$3,144
Aug. 21, 1945	20.1	278,760	24,240	0.1225	0.23	34,148	5,575	39,723
Aug. 21, 1945	23.7	329,820	28,680	0.1225	0.23	40,402	6,596	46,999
Feb. 19, 1946	8.8	138,120	10,130	0.115	0.13	15,883	1,316	17,200

For injecting the hot asphalt under the pavement, contractors' sealing crews employ nozzle units incorporating three-way valves and upstanding T-handles to aid in moving the nozzles from hole to hole. Two 1-in. metallic hose lines lead from the valve connection to the distributor. To prevent breakage of the metallic hose lines from repeated bending at the connections to the valve unit, the nozzle outfit is built with a horizontal steel frame to which the hoses are fastened.

Asphalt is injected into each hole until the slab has been raised to a string line set to grade. The three-way valve is turned to divert the flow of asphalt from the nozzle to the return hose line, and the nozzle is lifted from the hole. Immediately, a wooden plug is driven into the hole to stop backflow of asphalt. These plugs are removed after 3 to 5 min.

Wetting the pavement with a mop prior to injection of asphalt has proven more effective than using sand or other material around the drill holes to prevent adherence of asphalt. After removal of the wooden plugs, two workmen scrape spilled asphalt off the pavement surface and fill the drilled holes with small stone tamped in place.

Results of undersealing

Inspection of the first experimental undersealing work performed in May and June, 1944, has shown after 24 months in service that 90 percent of the slab is in satisfactory condition. Use of more suitable asphalt and improved procedure since the early experimental work was performed have greatly increased the effectiveness of undersealing.

Cores prove effectiveness

Additional recent information on the results of undersealing was given in a paper April 30 by M. C. Welborn, district engineer, during the Twentieth Annual Short Course in Highway Engineering at the A. & M. College of Texas. He reports that 88 cores 6 in. in diameter were taken on four of the ten projects listed in Table II, in an effort to determine the area under the pavement filled with asphalt.

In the areas sampled by these cores, asphalt had spread distances of 2 to 15 ft. from the pump hole. Thickness of asphalt under the slab ranged from $\frac{1}{16}$ in. to $2\frac{1}{2}$ in. In some places where rain had occurred following undersealing of the first lane and preceding sealing of the second lane, the cores revealed two layers of asphalt under the second lane, separated by a layer of earth or mud varying in thickness from fine sediment to $\frac{1}{2}$ in. Pumping action of the unsealed slab in the second lane evidently had displaced wet subgrade material and forced it over the bottom layer of asphalt, which had penetrated under this lane during the sealing of the first lane.

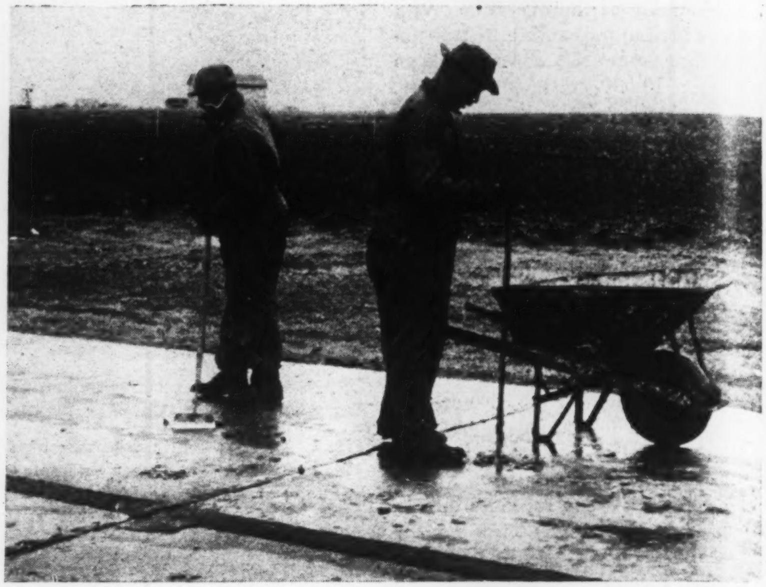


Fig. 4. Excess asphalt is scraped from wet surface of pavement, and holes are filled by tamping small stone into them after the temporary wooden plugs have been removed.

TABLE II—QUANTITIES PER MILE FOR TEN PROJECTS UNDERSEALED ON FOUR CONTRACTS IN 1945 AND 1946

Length, miles	Width ft.	Quantity per mile Asphalt, gal.	Holes
4.20	24	8,600	770
11.16	20	15,484	1,432
5.00	20	16,033	1,372
5.98	18	17,615	1,234
5.33	20	20,148	1,790
6.96	20	20,389	1,531
7.53	20	23,497	1,607
2.00	20	19,858	1,425
5.38	20	18,157	948
3.50	20	35,360	1,692
57.04	Average	18,966	1,396

Best results have been obtained by undersealing pavement in warm, dry weather. In warm weather, asphalt travels farther under the pavement, giving better coverage. Cavities under the slab are larger in dry weather than in wet weather when moisture causes swelling of the subgrade. Wet subgrade also produces foaming of the hot asphalt, with possible formation of trapped steam pockets in which water might later accumulate. In warm weather, also, fewer delays occur as a result of asphalt's freezing in the hose lines.

On slabs broken up in pieces less than 1 sq. yd. in area which are rocking and pumping, it has been found in about half the cases that asphalt of sufficient thickness cannot be placed under the slab to prevent pumping. These small slabs can be raised to a fair grade, but where the slab has settled more than $1\frac{1}{2}$ in. Mr. Welborn recommends undersealing the slab and smoothing up the surface with premixed asphalt patching material.

All undersealing operations in the Dallas District are under the immediate supervision of A. B. Griffin, district maintenance engineer, who pioneered the experimental work in his district. Melvin L. Smith, district mechanic, built the original injection equipment, since adopted with slight modification by undersealing contractors. M. C. Welborn, district engineer, has continued the undersealing program inaugurated by his predecessor, T. E. Huffman. For the Texas Highway Department, D. C. Greer is state highway engineer, and G. B. Finley is state maintenance engineer.

Avoiding Trouble on Government Bidding

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John Reich
Member, New York Bar

Attorneys for the U. S. Engineer Office, Providence, R. I., District

***Contents in Brief**—Some suggestions for avoiding difficulties in bidding on and getting paid for work on U. S. Government contracts. A "check list" outlines important items in preparing bids. Case references to decisions establishing fundamental policies are of value to the contractor's lawyer.*

"MEN WHO TAKE million-dollar contracts for government buildings are neither unsophisticated nor careless." The Supreme Court of the United States made this statement in the case of *Wells Brothers Co.* v. *United States* (254 U. S. 83). But the record of expensive litigations initiated by contractors attempting to recoup financial losses sustained through their own carelessness, hardly bears out this conclusion. Instances of such carelessness run the gamut from perfunctory examination and improper understanding of government bidding provisions to ordinary arithmetical mistakes in estimating quantities and computing unit prices.

During the war years, when the formal requirements affecting government procedure were somewhat relaxed, the strict measure of caution and prudence always demanded under normal competitive bidding conditions were sacrificed in the concerted effort to speed production of vitally needed material. With the war years gone, however, and with them the negotiated contract, it becomes appropriate for contractors, fresh from cost-plus undertakings and informal negotiations, to reacquaint themselves with the pertinent provisions contained in peacetime invitations and to appraise their implications.

Read the fine print, too

When the United States enters the field of commerce and enterprise it becomes a dual entity maintaining, on the one hand, its invulnerable position of sovereignty, and, on the other hand. negotiating as a business entity fully responsible for its contractual obligations. The "invitation for bids" is a solicitation of offers by the government in its character as a business entity, the offer or bid by the contractor representing the first step toward the procurement of the government contract, the acceptance constituting the second and final step leading to the execution of the formal contract. The invitation papers usually consist of the formal "Invitation for bids", an instruction sheet, the formal "bid" form, the specifications and the standard form contract which eventually will be executed.

Scrutinize every sentence

In all, the papers represent a formidable amount of reading matter, but it can not be emphasized too strongly that every single sentence should be closely scrutinized. Too many bidders examine the technical provisions of the specifications with the discerning eye of a horse trader, as they should, and then cursorily read the rest of the printed matter as one casually reads the foreword to a novel. The majority of lawsuits are not based on the technical provisions contained in the plans and specifications so much as they are on the construction of the other provisions, the contents of which the bidder usually overlooks or fails to appreciate.

The formal bid invitation commences with the recital that sealed bids will be received until a stated time and date, and then publicly opened. Inasmuch as government competitive bidding requires the strictest measure of fairness and impartiality, no bids may be opened before the appointed time and no bids considered which are received after that time. The Attorney General has ruled, however, that in the exceptional instance where a bid, obviously mailed in time to arrive before the bid opening, actually arrives a few minutes after the deadline, such bid may be considered (21 Op. Atty. Gen. 546).

After a bid has been submitted it may be modified or withdrawn at any time prior to the time fixed for the opening of all bids. Such modification may be effected by letter and also by telegram (22 Op. Atty. Gen. 45). No modification however may be made by telephone (17 Comp. Gen. 961). Between the time of the bid opening and the expiration of the period fixed for the government's acceptance, usually 30 to 60 days from the date of opening, bids may neither be modified nor withdrawn, except in certain cases later briefly discussed.

It is interesting to note in this connection that as between private individuals the law is well settled that, unless good consideration exists for holding an offer open for a definite period of time, it may be revoked at any time prior to its acceptance. Moreover, in 1858, and again in 1877, the Attorney General ruled that this principle of law also applied to offers received by the government and that such offers could be legally withdrawn in any time prior to acceptance (9 OP. Atty. Gen. 174; 15 id. 648). However, it has since been definitely established that a bid for a government contract may not be withdrawn after the bid opening, until the expiration of the government's time for acceptance, for the reason that the agents of the government, in the public interest, require a reasonable time for the examination of proposals (*Scott* v. *United States*, 44 Ct. Cls. 524).

The invitation usually reserves to the government the right "to reject any and all bids, to waive any informality in bids received, *and to accept or reject any and all items of any bids, unless the bidder qualifies such bid by specific limitation.*" (Italics are the authors'.)

The first part of this reservation, not in italics, is informative only, since the government has such right whether or not it is stated in the invitation. The italicized clause, however, should immediately engage the bidder's attention since the government apparently reserves the right to split an award on the basis of the respective low item bids received from the various bidders. In other words, if the bid schedule for a construction project contains thirty items and thirty unqualified bids are received, the government, by virtue of this reservation, may sever the work into thirty distinct parts and award a contract to each of the thirty bidders for the one item on which he was low. The illustration is extreme, of course, and such action on the part of a contracting agency unlikely, since the resulting bedlam of discordant activity scarcely would be deemed to be in the best interest of the government. However, such right in the government exists, and if a bidder desires to have his bid considered as a whole or not at all, he should so state.

Bid bond required

The bid bond is a guarantee to the government that in the event the bid is accepted the bidder will execute the required contract and furnish the necessary payment and performance bonds. When required by the invitation, the bidder should be careful to submit such bond in the proper amount. Ordinarily, except in connection with Navy Department bids, the failure of the low bidder to accompany his bid with the required bid bond may be waived by the contracting officer, unless such failure represents the bidder's habitual practice (14 Comp. Gen. 305; 16 id. 493).

When dealing with the Navy Department the bidder must take cognizance of an act designated as Section 3719 of the Revised Statutes, which expressly provides that every proposal for Navy supplies "shall be accompanied by a written guarantee signed by one or more responsible persons, constituting a bid bond." The Comptroller General, in construing this act, has ruled that the bid bond must always accompany the bid, and that the act is not complied with even though the contracting officer receives a wire prior to the hour fixed for the opening of bids stating that a bid bond has been issued by the surety and is being mailed to the contracting officer (10 Comp. Gen. 528).

Quantities, "more or less"

In preparing his bid on the basis of the estimated quantities shown, the bidder should note all statements in the specifications that qualify these quantities by such words as "about", "more or less" or "greater or less". A proper understanding of the effect of such qualification is necessary, especially in view of the amount of litigation in the past on this point.

The leading Supreme Court decision on quantities, decided in 1877 and followed to this day, is *Brawley* v. *United States* (96 U. S. 168). The facts in that case are interesting, if only for the reason that they were responsible for the important rules established in the judicial opinion. A contractor had undertaken to deliver to an army post 880 cords of wood "more or less, as shall be determined to be necessary by the post-commander". Within four days after the contract was executed the contractor was notified by the commander of the post that only 40 cords of wood would be required. In holding that the government was not obligated to take more than the 40 cords actually required, the court stated: "Where a contract is made to sell or furnish certain goods identified by reference to independent circumstances, such as an entire lot deposited in a certain warehouse, or all that may be manufactured by the vendor in a certain establishment, or that may be shipped by his agent or correspondent in certain vessels, and the quantity is named with the qualification of 'about' or 'more or less' or words of like import, the contract applies to the specific lot; and the naming of the quantity is not regarded as in the nature of a warranty, but only as an estimate of the probable amount, in reference to which good faith is all that is required of the party making it.

"But when no such independent

HOW TO ALLEVIATE LEGAL DIFFICULTIES IN BIDDING

As an aid in establishing good bidding procedure and minimizing the possibility of error it is suggested that this check list be reread in connection with the preparation of every bid.

1. Read all papers carefully.
2. Note any unclear or ambiguous provisions in the invitation paper and obtain clarification from the contracting officer in writing.
3. Visit the site with open mind but a definite "show me" attitude.
4. Obtain all pertinent information relative to site conditions or other factors involved and verify statements furnished by the government that are not covered by warranty.
5. Estimate prices carefully, bearing in mind the number of days the bid must remain in effect and the possible changes in market conditions during this period.
6. Check all arithmetical computation and stenographic transcriptions meticulously.
7. Qualify bid as to acceptance as a whole, if necessary.
8. Do not materially qualify the bid (except as in 7 above) since such qualifications will destroy its validity.
9. Obtain and submit bid bond in required amount.
10. Submit all addenda with the bid.
11. Mail bid in ample time (remembering, when time is short, that registered mail is slower than regular mail or special delivery) or deliver it in person.
12. Modify or correct bid before bid opening by letter, if possible, or by telegram and confirming letter.
13. Retain all original notes and estimates in an envelope sealed in the presence of another and place in latter's custody until after the bid opening, establishing this as your regular procedure.

circumstances are referred to, and the engagement is to furnish goods of a certain quality or character to a certain amount, the quantity specified is material and governs the contract. The addition of the qualifying words 'about' or 'more or less', and the like, in such cases, is only for the purpose of providing against accidental variations arising from slight and unimportant excesses or deficiencies in number, measure or weight.

"If, however, the qualifying words are supplemented by other stipulations or conditions which give them a broader scope or a more extensive significancy, then the contract is to be governed by such added stipulations or conditions. As, if it be agreed to furnish so many bushels of wheat, more or less, according to what the party receiving it shall require for the use of his mill, then the contract is not governed by the quantity named, nor by that quantity with slight and unimportant variations, but by what the receiving party shall require for the use of his mill; and the variation from the quantity named will depend upon his discretion and requirements, so long as he acts in good faith. So where a manufacturer contracts to deliver at a certain price all the articles he shall make in his factory for the space of two years, 'say a thousand to twelve hundred gallons of naphtha per month, the designation of quantity is qualified not only by the indeterminate word 'say', but by the fair discretion or ability of the manufacturer, always provided that he acts in good faith . . . ."

Mistakes can happen

On the principle that the government is neither the guardian nor the executioner of negligent bidders, the courts have established the equitable proposition that, once bids have been opened, a bidder may not be relieved from the consequences of a mistake caused by his own negligence unless the mistake is so obvious that the contracting officer is put on notice at the time of the opening. For this reason the exercise of extreme care in the preparation of bids is of tremendous importance. The bidder should check all arithmetical computations and stenographic transcriptions meticulously before submitting his bid.

If in spite of all precautions a bidder discovers that he has committed an error which would place him in a difficult position if his bid were accepted as submitted, he should immediately notify the contracting officer and inform him of the facts involved. Although his chances of withdrawing the bid might be slim, he would at least be taking affirmative action during the time such action should be taken—while the contract is still unexecuted. On the other hand, if the contracting officer knows, or has reason to suspect, because of the amount of the bid or otherwise, that the bidder has made a mistake, he should, according to the decisions of the Comptroller General, request the bidder to verify his bid (7 Comp. Gen. 325; 8 id. 397). In the event the bidder then confirms the error the bid may be withdrawn (56 Fed. Supp. 505; 7 Comp. Gen. 325; 44 Ct. Cls. 127), but not modified (178 U. S. 373).

Where the mistake is a mutual one, however, both parties having done what neither actually intended, the situation can usually be remedied to give expression to their real intent (20 Wall. 488). For example, in *Morgan* v. *United States* (59 Ct. Cls. 650) the court held that where the bid for furnishing caskets read f.o.b. factory but through mutual error the contract, as executed, stipulated f.o.b. Brooklyn, New York, the contract should be reformed, the contractor being entitled to recover increased cost of delivering to Brooklyn.

Sanitary Landfill Used to Fill Cut In Residential Area

A sanitary fill recently completed in a residential district of Portland, Ore., has a history that offers encouragement to other cities. The incident arose from the desire to fill and hide an abandoned railroad cut that made an undesirable break in the natural contour of the district. When suggestion was made that the cut be used as a site for a sanitary fill, thus accomplishing two purposes in one operation, there was vigorous objection from local residents.

Despite these objections the council decided to make a sanitary fill in the old cut.

Because of the protests and the foreknowledge that nearby residents would be sensitive to odors or other nuisances, special endeavor was made to minimize any objectionable features. Enough material to completely cover the garbage was hauled in daily and no garbage was left exposed overnight.

The cut had a maximum depth of about 30 ft. The program was to put in four layers of about 10 ft. each, rolling each layer to a thickness of less than 8 ft., including the earth used for cover. The fill required a total of 24,000 loads of garbage at 8 cu. yd. each and the operation continued some 13 mo. before the job was completed in its entirety.

An 11-cu. yd. carrying scraper was used for bringing in cover material. This scraper and the garbage trucks, which brought the 8-cu. yd. loads, accomplished a great deal of compaction in moving over the fill. The amount of hauling and the arrangement of routes for the moving vehicles was such that an unusual degree of compaction resulted. An 8-cu. yd. load occupied about 3 cu. yd., on the average, when thoroughly compacted. Cover material used totaled about 20 percent of the compacted volume.

This cover material was obtained from adjoining property which was excavated to the same depth as the cut. The excavated area was then refilled with garbage, the same as the rest of the fill, using for cover material that had been stockpiled for that purpose. Considerable covering material was also received from private excavation projects.

The cost of the project, including cover material but not including depreciation or investment charges on the equipment, was about 44 cents per ton of garbage placed and covered. As the average weight was about 500 lb. per cu. yd., this figures out as some $21,120 for the 192,000 cu. yd. of garbage (before compaction) in the fill.

W. G. Helber is superintendent of the bureau of refuse disposal.

Circles of Stress and Strain Compared

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***Contents in Brief**—Computation of the stresses across the various planes at a point may be simplified and a graphical solution made available by the substitution of a circle for the ellipse of stress. This circle was obtained from the ellipse in different ways by Cauchy, Culmann, Ketchum, Mohr and Land. Similar circles may be applied to strains and moments of inertia.*

IN FINDING THE STRESSES at selected points on the surfaces of existing structures, due to actual load conditions, it is often necessary first to measure the deformations and then obtain the stresses from these. Not only the directions of the maximum and minimum stresses, but also their values may be found by means of a simple graphical construction involving a circle that has been developed from the less simple ellipse. This circle of stress has been worked out in several ways.

Since the circle and the ellipse are geometrically interrelated, the same construction and computations can be applied to problems involving strain and moment of inertia.

This type of problem frequently arises in practice. For example, when the maximum stress is desired in the spandrel walls of a concrete arch or the cover of an airplane wing. In some cases, the stresses across chosen planes can easily be computed, but determination of the direction and amount of the maximum stress is quite another problem. An example of this occurs in the case of a simple beam.

Ellipse of strain

It is easy to demonstrate that the strains at a given point follow a simple pattern. On a rubber sheet draw a small circle. Then any stretching or compression of the rubber transforms the circle into an ellipse, the ellipse of strain.

To determine the strains at a point on the surface of a body, three measurements in known directions are required. From these measurements the

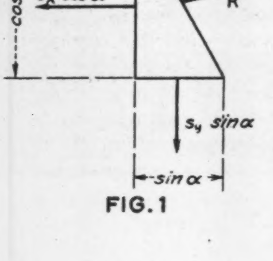


FIG. 1

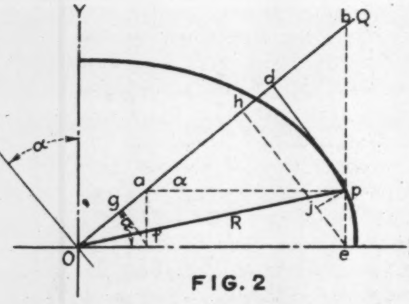


FIG. 2

Fig. 1. Stress at a Point—On principal planes through a point, represented by the vertical and horizontal lines, there are normal stresses only, such as s_x and s_y. There are no shear stresses. In general, the stress *R* across any plane may be resolved into a direct stress s and a shear s_s. When *R* is plotted vectorially, the locus of its end traces an ellipse, as α varies, as shown by the following: $x = s_x \cos\alpha$ and $y = s_y \sin\alpha$. Elimination of α gives $(x/s_x)^2 + (y/s_y)^2 = 1$.

Fig. 2. Ellipse of Stress—To plot the ellipse of Fig. 1 on axes OX and OY, let OP, making an angle α with OY, rotate counter-clockwise. On OQ, perpendicular to OP, lay off $Ob = s_x$ and $Oa = s_y$. The intersection of bp and ap, drawn parallel to OY and OX, respectively, determines point p, which, as α varies, traces an ellipse with major and minor axes of s_x and s_y. Then, $Od = s$ and $dp = s_s$, according to Fig. 1, since $Oe = s_x \cos\alpha$; $af = ep = s_y \sin\alpha$

Fig. 3. Circle and Ellipse—If, instead of holding OY fixed, as in Fig. 2, hold OP fixed and let OY rotate clockwise. Points a and b remain fixed; ap and bp continue perpendicular and parallel to OY. Then, p will trace a circle about c with an angular movement twice that of OY. $Ob = s_x$, $Oa = s_y$, $Od = s$ and $dp = s_s$.

Fig. 4. Combination of Stresses—Normal forces and shears are given on the vertical and horizontal faces of the small triangle, in which face B is taken as unity, A as $\cot\alpha = m$ and P as $\csc\alpha = n$.

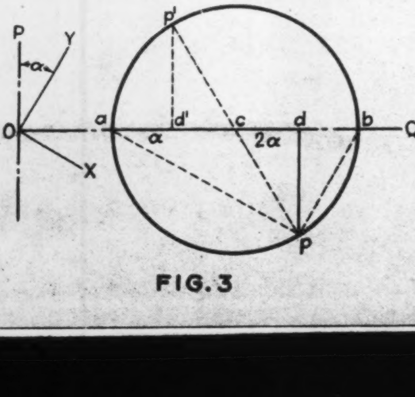


FIG. 3

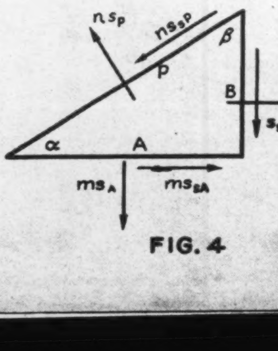


FIG. 4

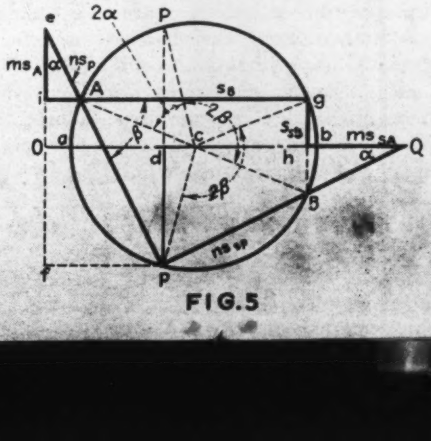


FIG. 5

strains at the selected point across any plane perpendicular to the surface can be computed, including the maximum strain, both in amount and direction.

Since stress is proportional to strain, the major and minor axes of the ellipse of strain will correspond to those of the ellipse of stress, and the amount and direction of the maximum and minimum stresses, s_x and s_y, at this point may be found from the equations:

$$E\epsilon_x = s_x - \lambda s_y$$
$$E\epsilon_y = s_y - \lambda s_x$$

where ϵ_x and ϵ_y are the maximum and minimum strains and λ is Poisson's ratio. It follows that:

$$s_x = \frac{\epsilon_x - \lambda \epsilon_y}{1 - \lambda^2} E$$
$$s_y = \frac{\epsilon_y - \lambda \epsilon_x}{1 - \lambda^2} E$$

The problems that arise from these ellipses are very much simplified by the relationship between the circle and the ellipse. This was first shown as a mathematical oddity in 1829 by Cauchy with no thought of its application to stresses and strains. It allows one to evaluate many of the dimensions of the ellipse by means of those of the much simpler circle (Fig. 2 and 3).

Since the sum of the shears across two planes at right angles to each other is zero, it follows that if the shear across one (plane 1) is s_s, the shear across the other (plane 2) is $-s_s$. A third plane (plane 3) across which the shear is zero can be found passing through the point of intersection of the first two because, if the angle between planes 1 and 3 varies from 0 to 90 deg., the shear will change from positive to negative without passing through infinity. At some value of the angle, it must pass through zero. The plane perpendicular to this position of plane 3 will also have zero shear across it. These two planes, subject to direct stress only, are known as the principal planes, and the stresses across them as principal stresses.

Circles of stress

In Fig. 1 the principal planes at a point are assumed, for convenience, as vertical and horizontal. A third, diagonal plane is taken at a very short distance from the point. Thus, the three planes form a very small triangle, in which the scale is chosen to make the hypothenuse unity. The stress on the third plane that is necessary to hold the triangle in equilibrium is plotted vectorially in Fig. 2 and 3. As the diagonal plane rotates (α varies), point p traces out an ellipse (Fig. 2). If, on the other hand, the diagonal plane is held fixed and vertical while the principal planes rotate (α varies in an opposite sense), the curve traced by point p is a circle (Fig. 3).

This circle was obtained by starting with the planes of zero shear. This is not necessary since the circle can be drawn if enough data is available to locate three points on it, after which the principal planes can be found if desired.

Each point on the circle corresponds to a plane, and if a plane is rotated counter-clockwise through an angle α, the corresponding point rotates clockwise through an angle of 2α. This relationship supplies sufficient data to locate the plane that corresponds to any given point, including the principal planes (points a and b) and the planes of maximum shear, which are 90 deg. from these two on the circle or 45 deg. from their corresponding planes.

In 1866, Karl Culmann of the University of Zurich published the first analysis of the combination of stresses by means of the circle of stress. He combined vectorially the forces acting on the small triangle of Fig. 4. In the case he described, s_A was taken as zero; otherwise his demonstration was about the same as that given in Fig. 5. The circle arrived at, obtained by means of stresses and their vectors, is the same as that shown in Fig. 3.

As has been shown by the late Milo S. Ketchum, University of Illinois, the circle may be obtained by considering the principal stresses as composed of the sum and difference of two other stresses (Fig. 6).

Also, this circle may be developed algebraically. In Fig. 1, consider first the forces perpendicular and then those parallel to the hypothenuse of the triangle.

$$s = s_x \cos^2 \alpha + s_y \sin^2 \alpha$$
$$s_s = (s_x - s_y) \sin \alpha \cos \alpha$$

These equations check Fig. 2, where $Od = Oh + hd$, the first equation,

Fig. 5. Culmann's Circle—Starting at e, the given forces in Fig. 4 are plotted in order: ms_A, s_B, s_s, ms_s, ending at Q. For equilibrium, the two remaining forces, ns_{sP} and ns_P, which are, respectively, parallel and perpendicular to face P, intersect at some point p. Then, $iA = s_A$, being ei tan α, and $hB = s_s$ or hQ tan α. If, as α varies, A is held fixed, B will also be stationary, since $Ag = s_B$ and $gB = 2s_s$. Since Ap and Bp are perpendicular, p describes a circle with AB as diameter. $Od = fp = ns_P \sin \alpha = s_P$ and $dp = ns_{sP} \sin \alpha = s_{sP}$. Thus, the circle is the same as that in Fig. 3. Point A corresponds to plane A, point B to plane B. However, for s_{sP} to have the proper sign, the symmetrical point to p, or P, corresponds to plane P.

Fig. 6. Ketchum's Demonstration—Assume that s_x and s_y in Fig. 1 are given by the sum and difference, respectively, of two stresses, p and q. Thus, $p = (s_x + s_y)/2$ and $q = (s_x - s_y)/2$. The effect of p alone on the triangle of Fig. 1 is shown in (a), where the resultant stress on any plane is also p. This is indicated in the force diagram (b), since all the forces are proportional to the length of the faces on which they act. Similarly, except for direction, when q acts alone. The resultant stresses in Fig. 1 are obtained as indicated in (e). If the hypothenuse is held vertical and α varied, $Oc = p$ is fixed, cp rotates and point p describes the circle in (f) with a radius of q. This is the same circle as the one shown in Fig. 2 and 5.

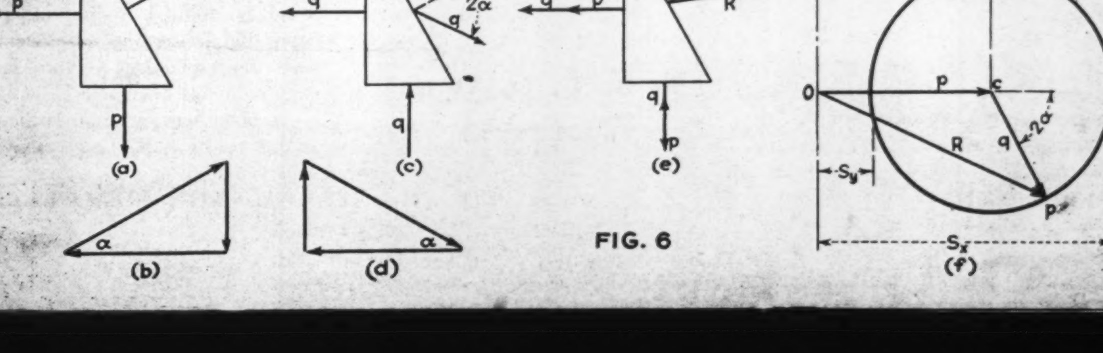


FIG. 6

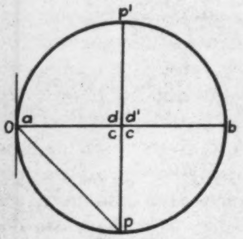


FIG. 7

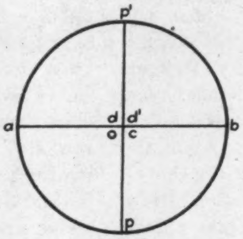


FIG. 8

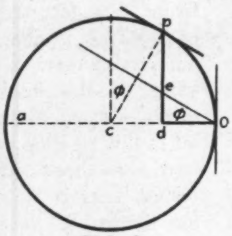


FIG. 9

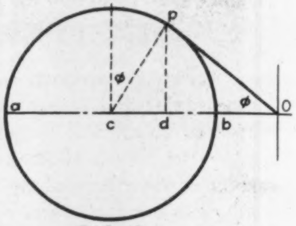


FIG. 10

Fig. 7. Bar in Tension—Circle of stress indicates that maximum shear occurs at 45 deg. with principal planes and equals half the tension.

Fig. 8. Pure Shear—The maximum and minimum stresses are on planes at 45 deg. to those of pure shear and equal the shear stresses.

Fig. 9. Short Column—Maximum shear occurs on a plane at an angle with a principal plane of 45 deg. plus half the angle of internal fraction. If there is no change in elastic properties before failure (the material is brittle, not plastic) failure should occur along this plane.

Fig. 10. Lateral Thrust—The circle is used to find minimum lateral thrust to hold a material like dry sand under vertical compression.

and $dp = he - ej = he - gj$, the second equation. The circle is developed directly from these equations by substituting the trigonometric identities expressing functions of twice the angle in terms of functions of the angles. Thus:

$$s = \frac{s_x + s_y}{2} + \frac{s_x - s_y}{2} \cos 2\alpha = p + q \cos 2\alpha$$

$$s_s = \frac{s_x - s_y}{2} \sin 2\alpha = q \sin 2\alpha$$

When s and s_s for all values of a are plotted, a circle whose radius is q and whose center is distance p from the origin results. (Fig. 3, 5 and 6(f), where $Oc = p = (s_x + s_y)/2$ and $cp = q = (s_x - s_y)/2)$.

Some simple applications of the circle to structural problems follow:

1. Required: The stresses across the various planes through a point in a bar in tension. Here s_x is the tension; $s_y = 0$. In Fig. 7, Ob is drawn equal to s_x and $Oa = s_y = 0$. The circle is constructed on ab as a diameter. The maximum shear occurs at p and the minimum at p'; and both cp and cp' are equal to $\frac{1}{2}$ Ob or ac, which is one-half the tension. The planes of maximum shear make angles of 45 deg. with the principal planes.

2. Required: The maximum and minimum stresses at a point containing a plane of pure shear, as occurs at the neutral axis of a beam. Here, the direct stresses on the vertical and horizontal planes are taken as zero (Fig. 8). Hence, $Od = Od' = Oc = 0$. and Op equals the given shear s_s. From this figure, we see that the planes of principal stress are 45 deg. from those of pure shear and that the maximum stress is Ob. or s_s. the minimum Oa or $- s_s$ (compression).

3. Required: The effect of the stresses at a point in a column under compression. The circle is plotted with the maximum stress zero and the minimum, being compression, located to the left of O (Fig. 9). The shear across the plane represented by p is *pd* and the thrust is *Od*. Not only must this shear overcome the resistance of the material, but it must also overcome the friction due to the thrust on the plane of failure. If the angle of internal friction for this material is ϕ and Oe is drawn making an angle ϕ with Oc, pd is divided into two parts—pe and ed. Stress $ed = Od \tan \phi$, or the thrust times the coefficient of friction, while stress *pe* is resisted by the material. When *pe* is a maximum, the tangent at p is parallel to Oe and angle $pcO = 90 - a$. Therefore, the plane of failure makes an angle of $45 + \phi/2$ with the plane having the principal stress across it.

4. Required: The minimum lateral thrust necessary to hold a material under vertical compression, internal friction alone being relied on for resistance. This occurs with dry sand under compression and held in place by a lateral stress. If, in Fig. 9, *pe* is changed to zero and *Ob* instead of being taken as zero is made the unknown value, Fig. 10 results. *Oa* is the vertical stress, *Ob* the horizontal stress and ϕ the angle of friction. Since $cp = Oc \sin \phi$, it follows at once that $Oa = Oc + cp = Oc (1 + \sin \phi)$ and $Ob = Oc - cp = Oc (1 - \sin \phi)$, whence

$$Ob = \frac{1 - \sin \Phi}{1 + \sin \Phi} Oa$$

This is Rankin's formula for lateral thrust. If *Ob* is less than the above value, *pe*, which has been assumed zero in Fig. 10, will be a positive quantity, and failure will result.

Circles of strain and inertia

In order to draw the circle of strain, the values of *X*, *dp* and radius *R* must be found. In the case shown in Fig. 11, where the strain measurements are taken in three arbitrary directions, the computations are involved, but *X*, *dp* and *R* can be obtained in terms of the three strain measurements and their directions.

If the strain measurements are made in special directions, however, the construction is somewhat simplified. Prof. Joseph A. Wise of the University of Minnesota has suggested that the directions of measurement be taken 45 deg. apart, making ($\beta = \gamma = 90$ deg., $\delta = 180$ deg. as shown in Fig. 11(b). Prof. R. D. Mindlin of Columbia University has suggested taking $\beta = \gamma = \delta = 120$ deg., as in Fig. 11(c).

As shown in Fig 12, the circle of strain is similar to the circle of stress.

In 1882 Prof. Otto Mohr of Dresden, Germany, followed the suggestion of Culmann, but expanded the idea to include stresses in three dimensions. Although first suggested and published by Culmann, the circle of stress is usually referred to as Mohr's circle. Prof. Mohr also showed how it can be applied to some other concepts that follow the elliptical curve when represented as vectors, specifically moments of inertia (Fig. 12).

An ingenious variation of the circle is due to Prof. R. Land (Fig. 13).

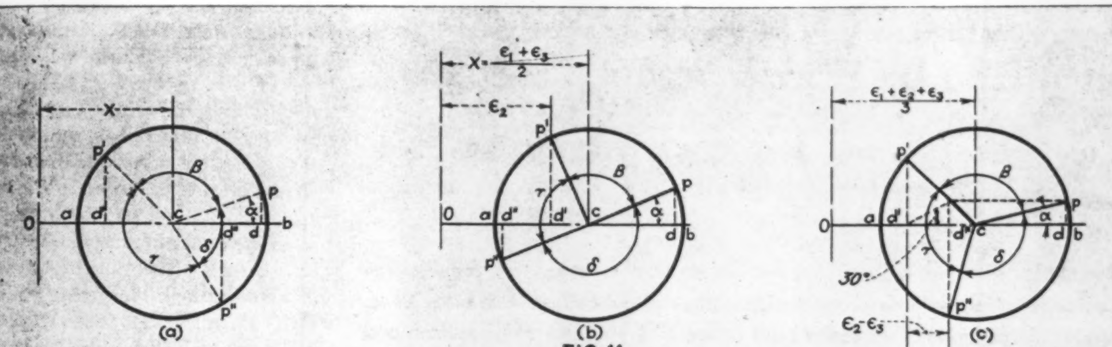

X
ε₁+ε₃ / 2
ε₂
ε₁+ε₂+ε₃ / 3
O
a
b
c
d
d'
d''
p
p'
p''
α
β
γ
δ
30°
ε₂-ε₃
(a)
(b)
(c)

FIG. 11

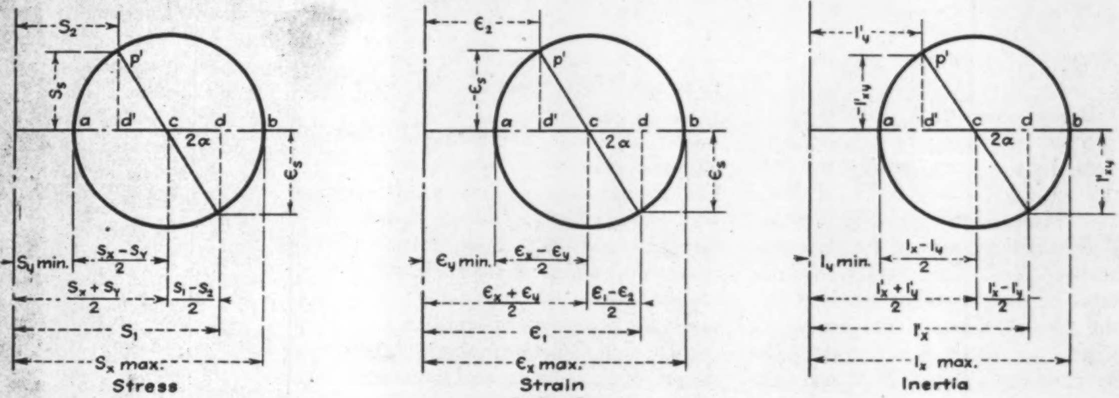

S₂
Sₛ
p'
a
d'
c
d
b
2α
Sy min.
Sx - Sy / 2
Sx + Sy / 2
S₁-S₂ / 2
S₁
Sx max.
Stress
ε₂
εₛ
εy min.
εx - εy / 2
εx + εy / 2
ε₁-ε₂ / 2
ε₁
εx max.
Strain
I'y
I'xy
Iy min.
Ix - Iy / 2
I'x + I'y / 2
I'x - I'y / 2
I'x
Ix max.
Inertia

FIG. 12

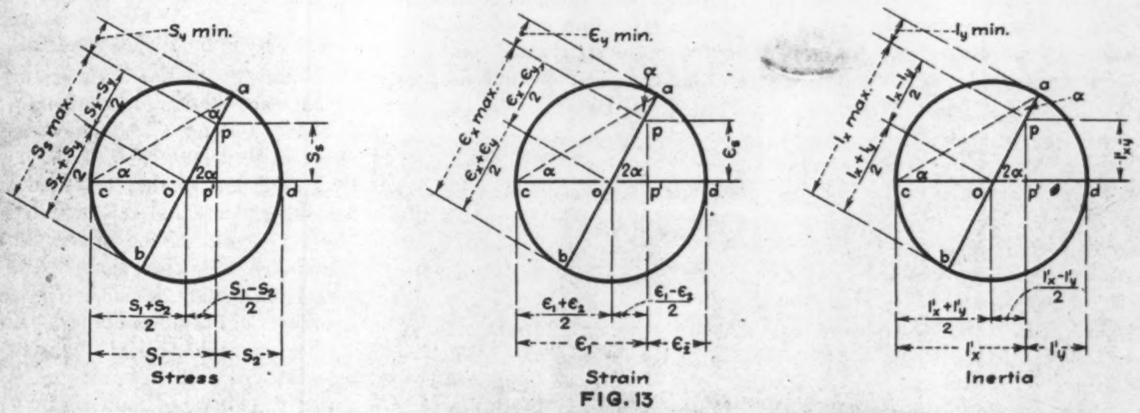

Sy min.
Sx max.
Sx-Sy / 2
Sx+Sy / 2
Sₛ
a
b
c
o
p
p'
d
α
2α
S₁+S₂ / 2
S₁-S₂ / 2
S₁
S₂
Stress
εy min.
εx max.
εx-εy / 2
εx+εy / 2
εₛ
ε₁+ε₂ / 2
ε₁-ε₂ / 2
ε₁
ε₂
Strain
Iy min.
Ix max.
Ix-Iy / 2
Ix+Iy / 2
I'xy
I'x-I'y / 2
I'x+I'y / 2
I'x
I'y
Inertia

FIG. 13

Fig. 11. Circle of Strain—Three measurements of strain—$\varepsilon_1 = Od$, $\varepsilon_2 = Od'$, and $\varepsilon_3 = Od''$—across planes represented by points p, p' and p", respectively, determine the circle in (a). Double the values of the angles between these planes are shown. The unknowns are α or dp, determining the directions of the principal planes of strain, the radius of the circle R, and distance Oc or X. In (b), the directions of measurement are taken 45 deg. apart, in which case $cd = cd''$, locating **c**, and $dp = cd'$, thus determining the circle. When the measurements are taken 60 deg. apart, as in (c), $X = (\varepsilon_1 + \varepsilon_2 + \varepsilon_3)/3$ and $dp = (\varepsilon_2 - \varepsilon_3)/\sqrt{3}$. The center of the corresponding ellipse of strain (the curve into which a small circle is transformed under stress) is one-half gage length to the left of O.

Fig. 12. Circles Compared—Similarity between the formulas for moment of inertia and product of inertia and those for stress and strain are indicated by the circles. If an area has a moment of inertia of I_x about axis X—X and of I_y about Y—Y and a product of inertia of $I_{xy} = 0$, the corresponding values about axes making an angle of α with the original axes may be found by use of the transformation formulas of analytic geometry. Thus, $I'_x = I_x \cos^2 \alpha + I_y \sin^2 \alpha$, $I'_y = I_x \sin^2 \alpha + I_y \cos^2 \alpha$ and $I'_{xy} = (I_x - I_y) \sin\alpha \cos\alpha$. Note the similarity to the formulas given for s and s_s in terms of s_x and s_y.

Fig. 13. Mohr-Land Circle—A comparison of the circles in a variation due to Prof. Land shows that the construction is correct. If a comparison with the ellipse of strain is desired, the radius of the Land circle must be increased by one-half the gage length. This construction is based on relationships previously mentioned and on the fact that the sum of the direct stresses on any two perpendicular planes is equal to the sum of the principal stresses.

Variety of Treatment Methods Utilized by French Water Company

M. N. Baker
Associate Editor, Engineering News-Record (retired)

Contents in Brief*—Supplying water in several areas of France, the Compagnie Generale des Eaux practices several methods of treatment at its various installations. Included are double filtration, chlorination and ozonation. Limited use is made of coagulants. Special mechanical washers are used to clean the filter media at the plants serving the Paris suburbs.*

VARIETY of treatment methods is a keynote in operations of one of France's major water utilities. This private concern, the Compagnie Generale des Eaux supplies water to the multitudinous suburbs of Paris and those of Lyons, to Nice and the Fench Riviera as well as to several smaller cities. The following descriptions of the processes employed and the present status of the company's major plants are taken from notes supplied by G. Huvelin, assistant manager of the company.

Of the water supplied to a vast suburban area surrounding Paris and having a population of 2,227,000, about one-fifth is drawn from deep wells. This well water requires no treatment other than that for iron removal.

The remaining four-fifths of the water for the Paris suburbs comes from the Rivers Seine, Arne, and Oise. Water from these surface sources receives two-stage slow filtration through open beds of sand 3 ft. deep, after which it is chlorinated. Between the two stages of filtration copper sulphate and alum are added, the copper sulphate being used to prevent algae growth on the final filters, particularly in summer. Alum is used only to lay a thin bed of floc on the surface of newly cleaned filters.

Pre-filters were put into use in the Paris suburbs in 1910 with successive additions until 1936. Chlorination with calcium hypochlorite was started in 1917, but in 1933 a change was made to liquid chlorine. Use of alum after pre-filtration was adopted in 1931, and of copper sulphate in 1938.

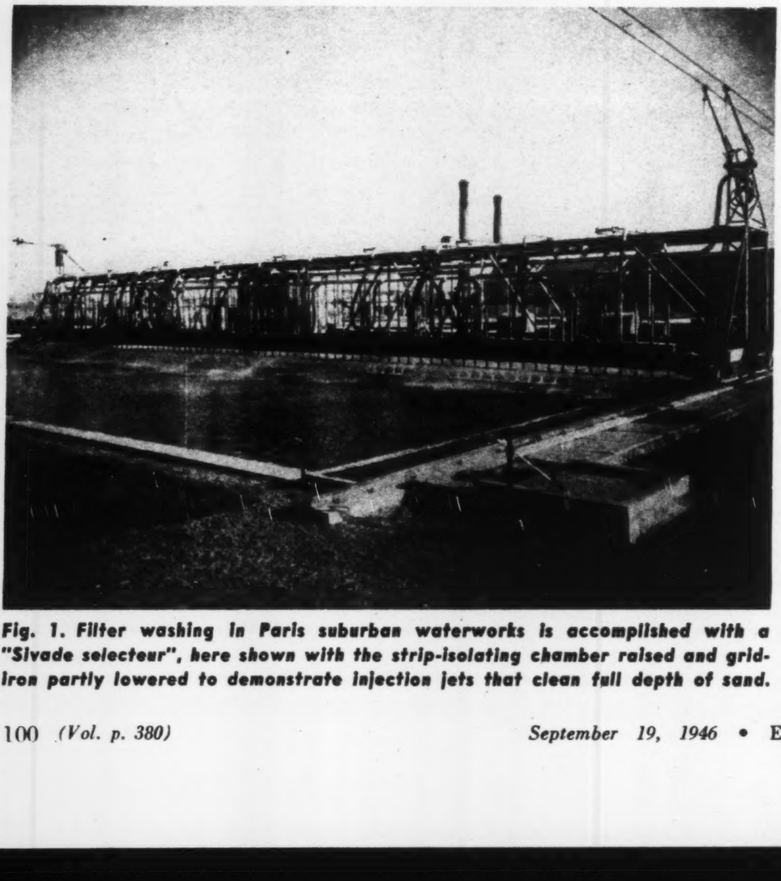


Fig. 1. Filter washing in Paris suburban waterworks is accomplished with a "Sivade selecteur", here shown with the strip-isolating chamber raised and gridiron partly lowered to demonstrate injection jets that clean full depth of sand.

Area of the suburban Paris prefilter is 23,340 sq. m. (5.78 acres); that of the final filters is 74,000 sq. m. (18.3 acres). The rate of filtration for the combined filter area, which is 97,340 sq. m. (24.08 acres), is 4.05 mgd. per acre. This rate, according to Mr. Huvelin, occasionally may be raised in summer, when the raw water is very clear. Consistently good results have been obtained under these circumstances at a rate of 6 mgd. per acre for the combined area. In contrast to some of the plants of the Puech-Chabal system mentioned further on, no cascade aeration is provided between the pre- and final filters.

Grain size of the sand in the prefilters runs from 0.75 to 3 mm. Prefiltration is carried on at a rate of 25 c.m. per sq. m. per day (about 26.7 mgd. per acre). Final filtration is carried on at a rate of 5 c.m. per sq. m. per day (about 5.3 mgd. per acre).

Selective filter cleaners

Filters in all the Paris suburban plants are cleaned mechanically by "Sivade selecteurs", which were put into us between 1931 and 1939. So far as is known they are used only at these plants and at Istanbul, Turkey. Patents on the apparatus are held by the Compagnie Generale des Eaux and Mr. Sivade, retired chief engineer of Filtration Cie le des Eaux.

The machine (Fig. 1) consists essentially of a truss framework spanning the filter bed and supporting a sheet-metal chamber and a gridiron of pipe. The framework is movable along the length of the filter bed by means of trucks at its ends rolling on rails set along the longer sides of the basins.

Operation of the machine is simple. The apparatus is rolled into position above the filled basin, and the chamber is lowered on the sand. Inside the zone or strip thus isolated, the sand is washed to its full depth by injection of clean water into the sand bed from the lower pipes of the gridiron. Dirty water from above the surface of the sand is removed by suction through another set of pipes. When one strip of sand has been completely washed, the gridiron and chamber are lifted and the machine moved to cover an adjacent zone or strip. The entire bed is cleaned in this manner.

The Sivade machine differs from the Blaisdell washer, used at a few plants in the United States, in that it does not cause any mixing of the sand by mechanical methods.

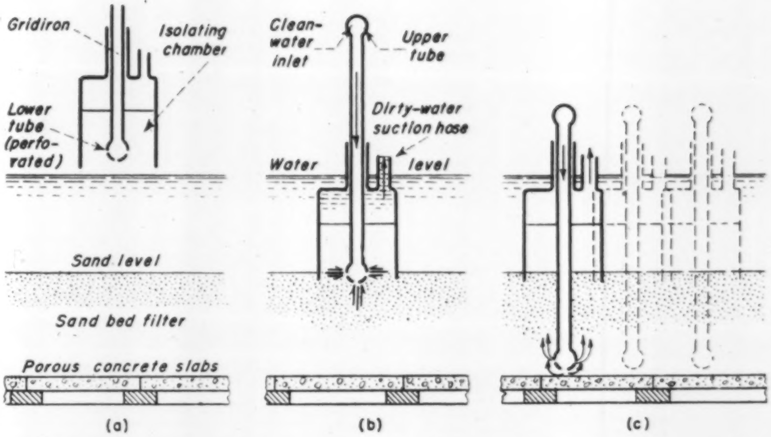


Fig. 2. Steps in washing of slow sand filter with "selecteur" are: From traveling position (a) the chamber and gridiron are lowered to sand surface (b); gridiron washes its way down through the sand (c) until it reaches the filter bottom, when it is withdrawn and the entire apparatus moved to an adjacent strip.

Ozonation used at the Riviera

Water supplied to the 325,000 inhabitants of Nice and the French Riviera comes by gravity from mountain streams. After one to two days of sedimentation, aided by coagulation with alum when turbidity is present, it is filtered and ozonized.

The uncovered slow sand filters are 2 to 3 ft. deep, the sand ranging in size from 0.5 to 3 mm. Filtration rate at this plant is 8 c. m. per sq. m. (8.56 mg. per acre) per day. Water is drained from the filters once a month as a routine operation so that surface slime and dirt may be scraped off by hand. All the sand is removed and replaced with washed sand yearly.

In this system, there are four ozonation plants with a combined treatment capacity of 70,000 c.m. (18.5 mg.) per day. Power for producing the ozone is supplied by hydroelectric plants operated by the water being treated.

For the 220,000 population of the suburbs of Lyons, water is supplied from wells and treated only by chlorination.

Early opposition against treatment

In order to understand some of the modern developments in French water treatment practice some of the high points of progress of water purification in that country should be reviewed. Although many inventors promoted filters in France from the middle of the eighteenth century onward, installations following their designs were few and small, and generally confined to street fountains in public squares. A notable exception to this was a privately-owned filtration plant on the Quai des Celestins, in Paris. From this plant, which was completed about 1805, water was distributed by carts.

Despite the widespread use of slow sand filters in Great Britain from about 1830 onward, it was not until the 1890's that the city of Paris introduced them. Just before the close of the nineteenth century, Armand Puech developed a multiple system consisting of roughing, pre- and final filters with cascade aeration between each stage. Size of the filtering material decreased in the successive groups of filters, the filter areas decreasing and the rates of filtration increasing correspondingly. This system, as improved by H. Chabal, was adopted for treatment of the water supplies of many French cities and part of the supply of the city of Paris. One of the claims for the Puech-Chabal system was that it obviated coagulation. At a much later date, coagulation was introduced, and still later chlorination was adopted in some plants.

Mistrust of slow sand filtration and prejudice against coagulation, the latter strongly expressed in the late 1830's by Dominique Arago, secretary of the French Academy of Sciences, was largely responsible for the adoption of double filtration in France and also for the existence of more water ozonation plants in France than in any other country in the world. It also accounts to some extent for the lack of uniformity in treatment processes employed by a progressive water utility.

This same use of different treatment methods is a factor in the repair of war damage sustained by the company's several plants. On the one hand, lack of uniformity makes it impossible to substitute in a damaged plant apparatus or parts from an undamaged one; on the other hand, this same lack of uniformity means that repair and replacement parts come from several sources, thereby making for quicker fabrication and delivery. Status of repairs to the principal installations of the concern, as of July 5 this year, are outlined by Mr. Huvelin as follows:

The main plant (at Choisy-le-Roi) of the Paris suburban works was seriously damaged in two air raids aimed at adjacent railway tracks. Sand filters were hit, considerable lengths of the main collectors being broken. In addition, two pumping stations were smashed flat. Permanent repairs to the facilities are held up for lack of cement and steel, although the equally heavy damage to the distribution network has been almost completely fixed.

Reconstruction of an important emergency pumping station in the Nice and Riviera system is well under way. This station also was completely demolished by the many air raids aimed at a nearby railway bridge.

Other company waterworks, notably those at Boulogne-sur-Mer and Rennes, were hard hit, especially as regards piping networks and reservoirs. Reconstruction of the distribution systems is well under way and is proceeding rapidly, but reservoir repairs have been limited to those necessary for current operation.

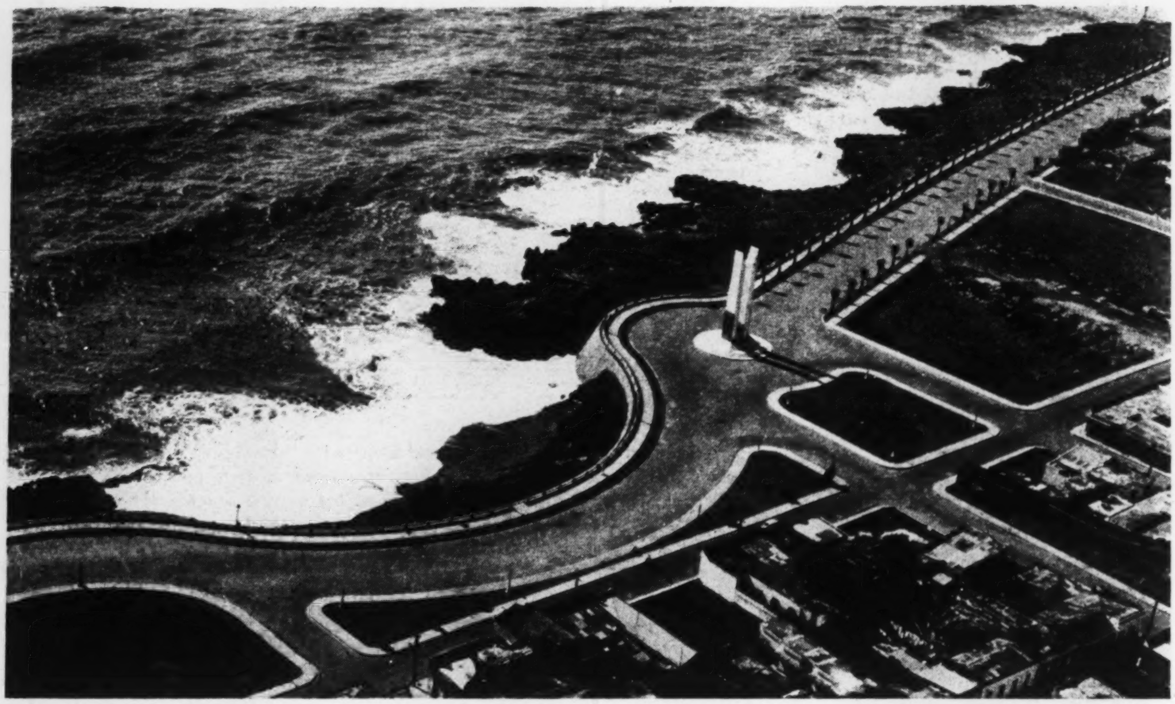


Fig. 1. George Washington Avenue in Ciudad Trujillo provides an unusually fine waterfront boulevard improvement.

Dominican Republic Pushes Public Works

McGraw-Hill World News

Mexico City Bureau

UNDER THE ENERGETIC—and what is sometimes described as ruthless—management of its President Leonidas Trujillo, the little Dominican Republic of less than two million inhabitants is making substantial progress in the promotion of public works. Roads and bridges have been completed, irrigation canals extended and impressive public buildings and avenues are being built in the nation's 130,000-soul capital Santo Domingo, renamed Ciudad Trujillo.

Practically destroyed in 1930, eighteen days after Trujillo took over the reins of government, by a terrific cyclone which killed 3,000 people and hit 15,000 more, the Dominican capital is now in the process of becoming a surprisingly modern city.

Roads and bridges

Ten years ago there were practically only three highways in the republic, all starting from the capital, one going to the eastern end of the island, one to the west, and one to the northwest, totalling some 450 miles.

Today, numerous feeder roads are in use, connecting these trunk-highways with previously out-of-the-way places and facilitating produce-exchange.

These new highways total 1,550 miles of paved roads, 1,050 miles of all-weather roads, and 1,180 mi. of dirt-roads. They include a 29-mi. long international highway, completed in August, 1943, in accordance with a Dominican-Haitian treaty of 1936. This serves partially as a frontier line between the two republics. The cost for the Dominican Republic alone was $424,000.

Twelve new highways, totalling some 400 mi., are still uncompleted.

During the same period, 14 steel and 55 concrete bridges were built at a total cost of $1,896,000. The most important are:

The Ramfis bridge, over the Higuano River. This is said to be the largest suspension bridge in the Caribbean area. It is 1,044 ft. long, 20 ft. wide and 72 ft. high.

The President Peynado bridge, over the Isabel River, is a steel-truss structure, supported on a 105-ft. deep concrete foundation. The overall length is 837 ft. and the height is 44 ft.

The Julia Molina bridge over the Ocoa River is the longest in the Dominican Republic, with a length of 3,500 ft., and a width of 18 ft.

The General Trujillo bridge, over the Yuna River is a 450 ft. long and 18 ft. wide steel structure.

The San Rafael bridge over the Yake del Norte River, 800 ft. long and 18 ft. wide, was the first suspension bridge built in the republic.

In recent years the Dominican Republic has turned into a rice exporting country. This was made possible by the building of a network of 18 irrigation canals. These range in capacity from 52 cfs to 250 cfs.

When all canals are completed,

which is expected to be in 1947, the total irrigated surface will reach some 173,000 acres, or 6 percent of the total cultivated area of the country. Most of this irrigated land is to be used for rice cultivation.

Public buildings stressed

It is especially in the capital city of Trujillo that building works, sponsored almost exclusively by the government (the president controlling practically all the economic activity of the country) has made striking progress. New government buildings have gone up like mushrooms after a rain, wide avenues were built and a harbor capable of accommodating seagoing vessels has been completed. Not the least interesting improvement is a waterfront boulevard known as George Washington Avenue.

Among the most important buildings recently completed are:

The Palace of Justice, a 34,000-sq. ft. building of very modern lines.

The central post office and Ministry of Communications, an elegant building with square columns of imported Virginia marble.

The Hotel Jaragua, largest in the Caribbean, built in 1942 at a cost of $400,000.

Three buildings for housing the government departments of public education, agriculture and health.

A tuberculosis hospital, considered one of the most modern of its type; and a military hospital.

Among the projects recently started, but not yet completed, two call for special mention—the Capitol and the *Ciudad Universitaria* (University City).

A $1,500,000 capitol

The capitol, with an estimated cost of $1,500,000, will be the most expensive single building ever built in the Dominican Republic. Its general aspect, with dome and frontal columns, is inspired by the Washington, D. C., model.

The University City, located in the west part of the capital, will replace the antiquated buildings of the Santo Domingo University, which was chartered in 1538 and is said to be the oldest in the Americas. Started in 1944 and planned for completion in 1949, the new campus will include 16 buildings in an 8-acre park. Its cost is calculated at $2,000,000.

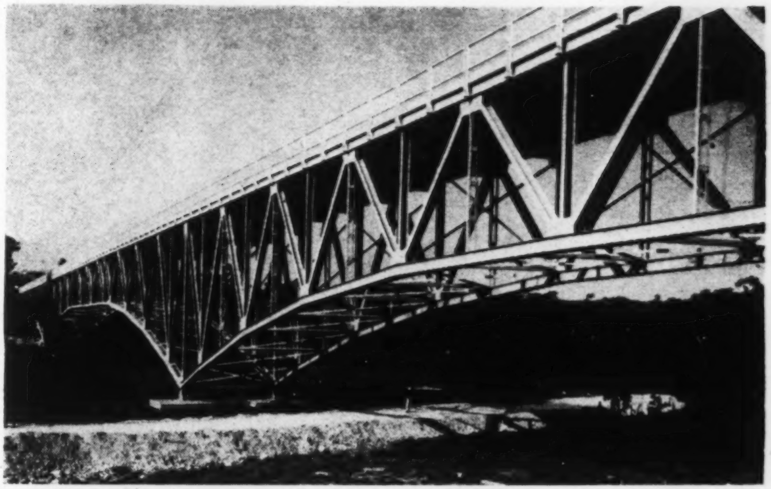


Fig. 2. The President Peynado bridge over the Isabel River is a steel-truss structure supported on a concrete foundation 105 ft. deep. The total length is 837 ft. and the height 44 ft.

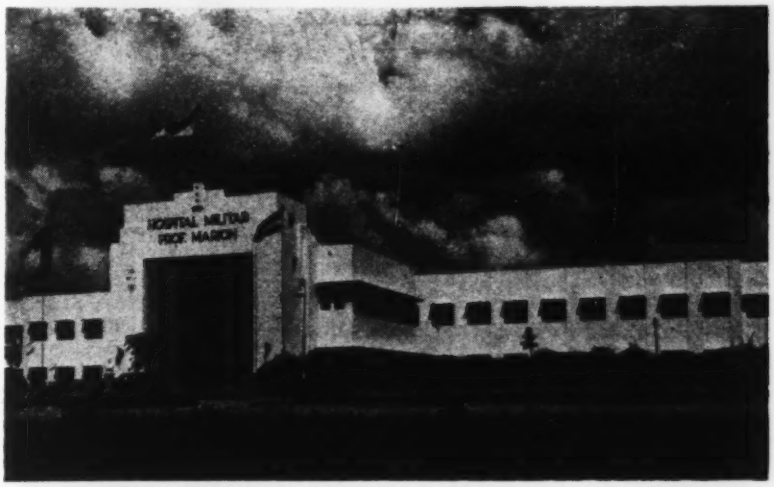


Fig. 3. The military hospital "Prof. Marion" is an impressive concrete structure and in its interior arrangements it is one of the most modern of its type.

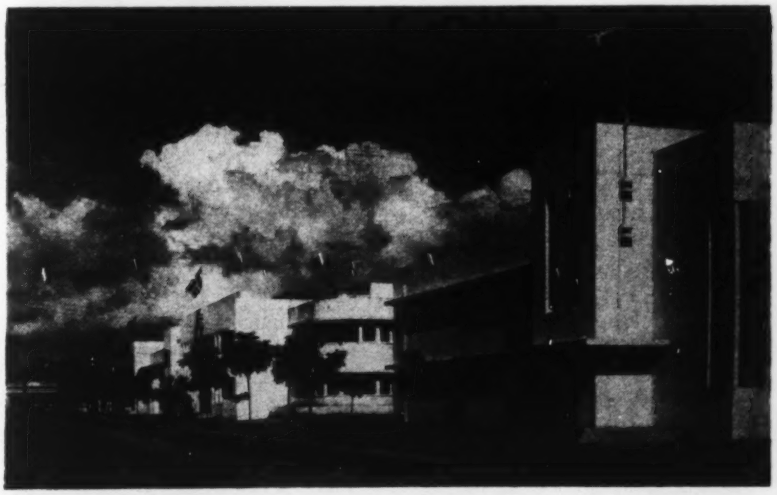


Fig. 4. From right to left: Ministries of Public Education, Agriculture and Health.

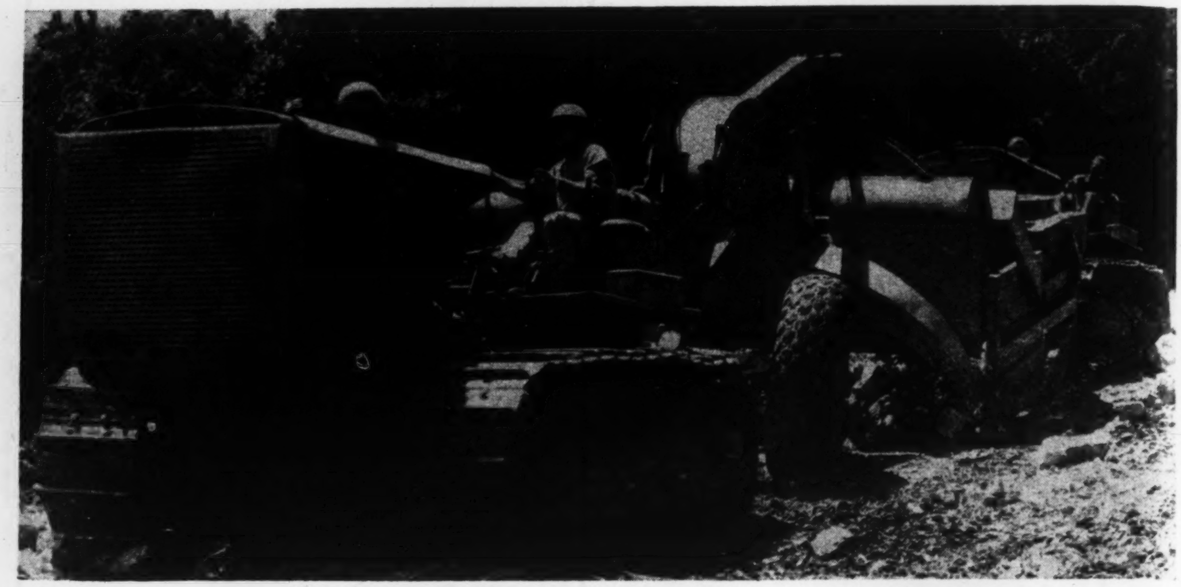


Fig. 1. Previously blasted rock is placed in the roadway embankment by tractor and carrying scraper.

Heavy Rock Excavation in Kentucky Hauled with Earthmoving Scrapers

Contents in Brief*—Conventional earthmoving scrapers move 75 percent of the heavy rock and earth excavation on a highway relocation project in Kentucky. Rock cuts are drilled 18 ft. deep and blasted with a concentration of shots to expedite moving the material by scraper.*

AN UNUSUAL SLANT on the proper selection of mobile equipment for heavy excavation is evidenced on a 2½-mile highway relocation project just south of Camp Nelson, Ky., on U. S. Highway 27, one of Kentucky's main north-south highways. Despite the fact that the 193,000 cu.yd. of excavation on this job averages over 70 percent limestone, requiring drilling and blasting, about 75 percent of it is being successfully hauled in conventional earthmoving scrapers. The remainder is moved by power shovel and dump trucks.

Mobile equipment on the job includes two 17-cu.yd. carrying scrapers, six 113-hp. and two 35-hp. (drawbar capacity) crawler type tractors, one 1¾-cu.yd. power shovel, two 10-cu.yd. dump trucks and one 12-ft. patrol grader.

One of the larger tractors can handle a loaded scraper on the rough embankment, but loading is accomplished by using a second unit as a pusher. The smaller tractors and two of the larger tractors are equipped with bulldozers to level the fills and to push the large rocks, many of which average 1-cu.yd. in volume, into place along the working face of the fill.

Designed to high standards

Roadway cuts are excavated to a width of 50 ft. between ditch lines, and to a maximum depth of 40 ft. Fills are built to a crown width of 38 ft., and to a maximum height of 48 ft. Finished grades are limited to a maximum of 6 percent, curvature to a maximum of 3½ deg., and sight distances to a minimum of 1,000 ft. When completed, some time this fall, this stretch of new highway will replace a section of former road containing many tortuous curves, some of which provides less than 100-ft. sight distance.

All excavation, including the 70 percent rock and 30 percent dirt, is being performed under a contract price of $0.76 cu.yd. and, despite the rugged nature of the work, the contractor reports very little wear and tear on his equipment. However, he had found it advantageous, from an equipment maintenance standpoint, to employ the patrol grader occasionally to fill and smooth ruts caused by the rubber tired hauling equipment. Needless to say, no compaction of the roadway embankment by use of rollers is attempted when the material is fundamentally rock excavation.

Heavy blasting required

One of the secrets of success in moving the rock excavation with earthmoving scrapers, and an aid in excavating by power shovel, is the method of blasting the rock. The Kentucky limestone, which occurs both in solid layers and in ledges, is drilled an average of 18 ft. deep.

Drill holes are spaced 5 ft. apart each way, staggered. Each hole is loaded with twelve ½-lb. sticks of 40 percent strength dynamite, and 140 holes are fired at one time; this is done with a blasting machine, by wiring the charges in seven parallel series of 20 shots each. This concentration of fire-power breaks the limestone into pieces easily handled by scraper or power shovel.

The blasting crew works two 10-hr. shifts per day and operates three wagon drills. Compressed air for operating the drills is supplied by two portable compressors, with their pressure tanks connected together by a 2-in. floating line to give a sufficient reservoir of compressed air to operate the three rigs. One compressor has a capacity of 220 cfm. and the other 330 cfm. Air pressure at 100 psi. is delivered to the drill rigs through air hose connected to a 3-in. outlet line.

Only one floodlight is needed for drilling at night. It is a 2,000-watt lamp fed by two 12-v. storage batteries. These are charged with a single phase, 1-kva. gasoline powered generator producing 115 v., 60 cycle current.

Engineers and contractors

A contract amounting to $200,000 for the 2½-miles of grade and drain, including small drainage structures, is held by the George H. Cheek Construction Co., Frankfort, Ky. John Bizzack is superintendent of construction.

The construction is under the supervision of G. R. Logue, director of construction, reporting to T. H. Cutler, state highway engineer, and to J. Stephen Watkins, highway commissioner. J. S. Hill is field engineer of the department's construction division, and C. E. Tate is resident engineer.

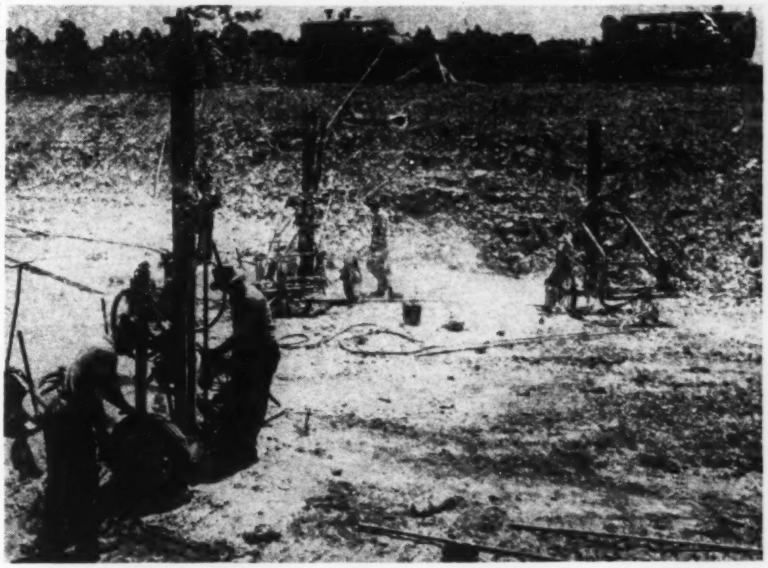


Fig. 2. Rock drilling and blasting continues in two 10-hr. shifts a day, using three rigs. Holes are spaced 5 ft. each way and drilled 18 ft. deep.

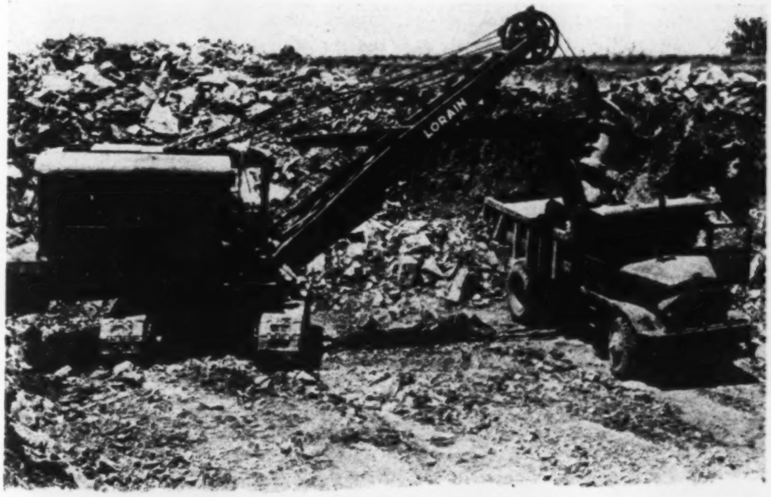


Fig. 3. Some blasted rock cuts are excavated more advantageously by power shovel. Note depth of material loosened by blasting.

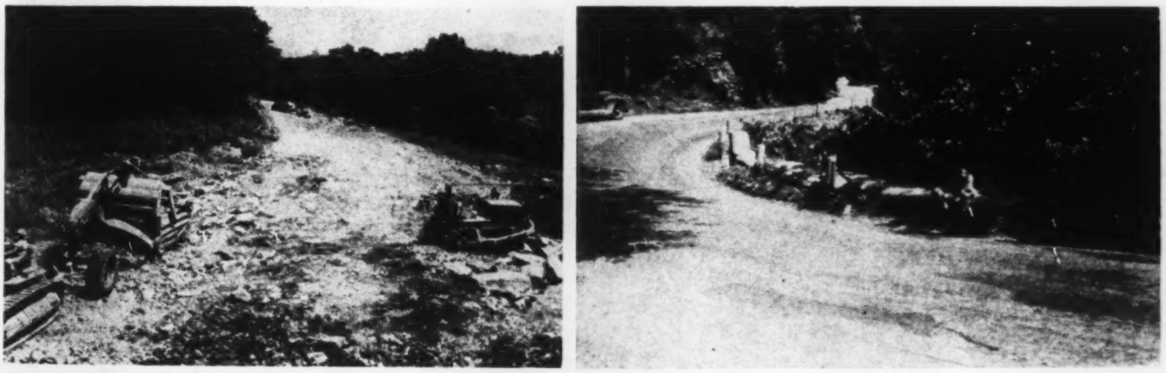


Fig. 4. When completed, the new highway will have long sight distances and easy curvature (left) eliminating a great number of dangerously short curves on the old road (right).

Fishways on the Fraser River Designed for Wide Head Variation

Contents in Brief*—A fishway problem involving hydraulic models, concrete design and a knowledge of the swimming abilities of sockeye salmon, was solved by designing a concrete structure using vertical baffles instead of the usual horizontal type. Two concrete fishways, built in Hell's Gate Rapids to specifications worked out by an international commission, are expected to increase the Fraser River salmon runs by millions of fish.*

FISHWAYS that would meet the requirements of migratory sockeye salmon at Hell's Gate on the Fraser River in British Columbia, called for something more than a fish "ladder" of the type frequently used in connection with dams. A rock slide had so constricted the channel at Hell's Gate that stream velocity at certain river stages was too swift for salmon to ascend. The canyon here is narrow. Records show water level variations as great as 98 ft., and sometimes changes come very suddenly. Thus it was undesirable to use any design that would require adjustments to suit varying water levels. The design finally worked out, as described in the following, was made to meet all requirements by using an arrangement of vertical baffles in place of the ordinary horizontal type.

Hell's Gate lies some 130 miles inland from where the Fraser discharges into salt water near Vancouver, B.C., at a point where the gorge is only 120 ft. wide at low water. Through this gap must flow runoff from a drainage of some 80,000 sq.mi., a mountainous area almost one-third again as large as the state of Washington. A serious channel constriction that obtains at Hell's Gate is ascribed to the dumping of rock into the river in 1913 in connection with railroad construction, and to a rock slide in 1914, which fell directly into the channel from the rocky bluff some 400 ft. above streambed.

Subsequent to that time it is reported that the upstream migrations of the sockeye salmon, which take place annually before November, have fallen off, at times almost to the vanishing point. This is ascribed to stream-flow characteristics in Hell's Gate, marked by violent turbulence and velocities as high as 24 fps.

Sockeye salmon, on their way to the Fraser River spawning grounds,

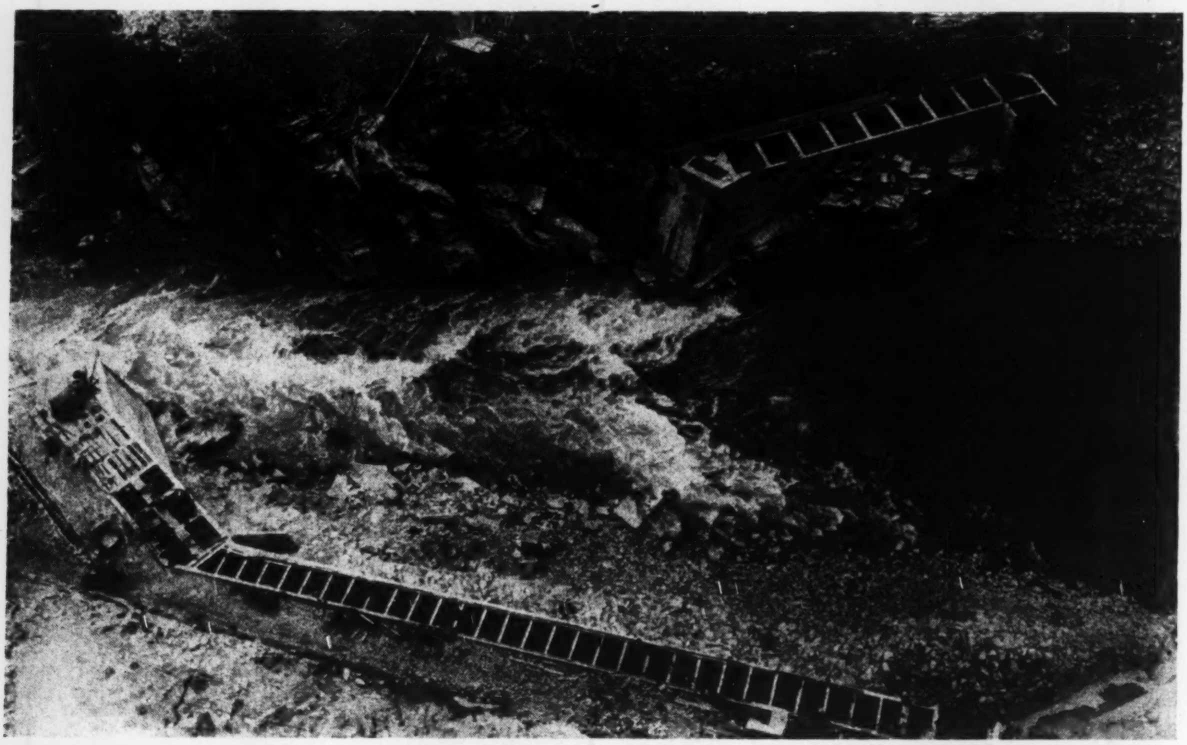


Fig. 1. These two fishways, built in the dry at low river stage, provide routes by which fish can pass upstream without overcoming excessive stream velocities in the narrow gorge.

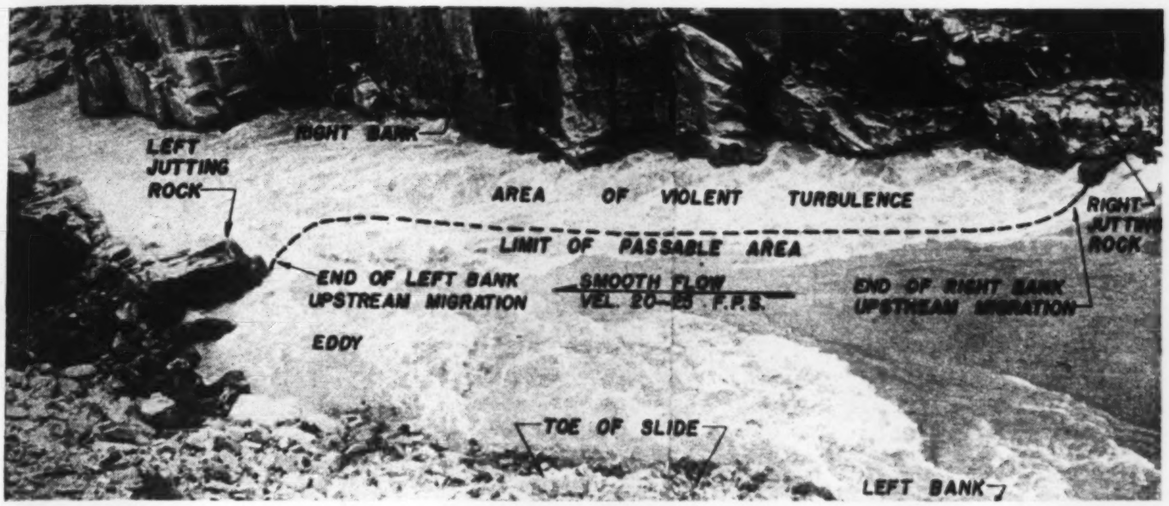

LEFT JUTTING ROCK
RIGHT BANK
AREA OF VIOLENT TURBULENCE
RIGHT JUTTING ROCK
LIMIT OF PASSABLE AREA
END OF LEFT BANK UPSTREAM MIGRATION
SMOOTH FLOW VEL. 20-25 F.P.S.
END OF RIGHT BANK UPSTREAM MIGRATION
EDDY
TOE OF SLIDE
LEFT BANK

Fig. 2. Flow conditions at Hell's Gate on the Fraser for a long time prevented many salmon from going upstream to spawn.

pass through Puget Sound and the Gulf of Georgia. The annual pack, in U. S. and Canadian canneries combined, has been as much as 2,000,000 cases of this variety of salmon. At present prices such a pack would have a value of $45,000,000. Depletion of the Fraser River sockeye salmon run is believed to have deprived the fishing industry of one-third of a billion dollars since the last big run in 1913. The removal of the block at Hell's Gate, believed largely responsible for this decline, was necessary before the annual runs could be fully reestablished.

Under the supervision of the International Pacific Salmon Fisheries Commission, which was appointed as the joint representative of Canada and the United States "for the protection, preservation and extension of the sockeye salmon fisheries in the Fraser River system," a careful study was made of possible means for removing the salmon block at Hell's Gate. Costs of what the commission does are shared equally by the two countries.

Engineering field studies that were begun in 1941 gave special attention to hydraulic conditions, particularly turbulence and velocity in different parts of the critical area in the channel. These observations were supplemented by work with a 1:50-scale model in the hydraulic laboratory of the University of Washington. The model provided data which, combined with observations in the field and records on salmon tagged during the migratory season, made it possible rather accurately to lay off the constricted channel area as shown in Fig. 2.

Based upon hydraulic conditions thus determined, attention was concentrated upon finding the most suitable remedial plan. Endeavor was first directed toward finding whether advantage would result from changes in the river channel itself. The model was made of concrete cast in units that made adjustment of the banks an easy matter. When the "right jutting rock" and bank area were removed it was found that the pool above dropped about 2 ft. at Gage 25 but showed only a 0.5-ft. drop at Gage 50. Removal of the "left jutting rock" and bank area resulted in lowering the pool 2 ft. at Gage 50. Removing both jutting rocks caused a pool-level drop of 2½ to 3 ft. attended by high velocities along the bank and complete alteration of the pattern of flow. The conclusion from these experiments was that alterations of the constricted channel would not provide a satisfactory solution.

Attention then was turned to providing fishways or passes for the fish through the impassable portion of the natural channel (see Fig. 2). Ultimate solution of the problem, checked thoroughly on the hydraulic model, was to provide two fishways, one on either bank of the river, as shown in Fig. 1. These fishways are located where they help the fish to get around the impassable current barrier indicated in Fig. 2. The structure on the right bank is 20 ft. wide and 220 ft. long; the one on the left bank has a 460-ft. length. Model tests indicate that these structures will cause no alteration in the drop through Hell's Gate nor in the flow pattern of the river. As the fishways will be at times submerged as much as 30 ft., deck grills for the full length of the structures are provided as well as trashracks at the upstream end.

Design of the fishway structures was complicated by the fact that two transcontinental railways pass through the canyon, one on each bank. Construction had to be carried on without interference with operation on these railways and any undermining of the roadway required the restoration of adequate support.

As the sockeye salmon runs are over by November, the two fishways had to be designed to function within the stream flow limits that obtain before that time. Fortunately these limits are above the low water stages that obtain for 60 to 120 days each winter. Thus by extending the work over two winter seasons, construction in the dry was possible and expensive cofferdams were avoided.

In designing the fishways themselves, certain requirements had to be met. The internal path for the fish had to be such as to enable them to pass without injury or delay. To accomplish this, velocity would have to be below the prohibitive velocity in the main channel and whatever baffles were used should not require

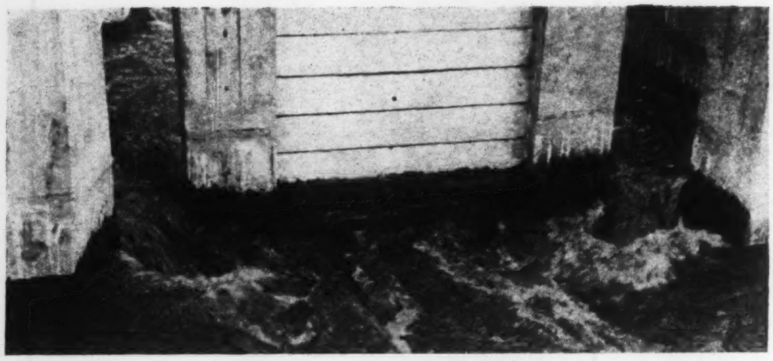


Fig. 3. Baffles of this sort, without requiring any adjustment, provide the same head differential per step over a wide range of river stages.

adjustment to meet changes in river stage likely to occur during the salmon run. Conventional horizontal baffles did not meet these requirements and experiments were made on vertical baffles that created two vertical slots, each 24 in. in width, extending the full height

Separating successive pools by central, vertical baffles, made it possible to direct the flow around the two edges of each baffle so that water poured through slots into the central portion of each successive downstream pool, making a pattern of flow in each pool suited to fish migration. This gave the desired gradation in the regimen of flow through the fishway and also provided desirable resting places in the pools for the fish.

Typical baffle design in sections 20 ft. wide, as indicated in Fig. 3, develops a one-foot difference in elevation between successive pools and this head difference, as well as the pattern of flow in the pools, remains constant at all operating levels. The only variable in the flow through the fishway is the quantity of water passing. The flow increases with river stage, hence making the "attractive flow," where the fish are to enter, proportional to stream flow.

Flexibility in the basic design was provided for by gates of three types. At the lower end of each fishway a knife gate operates over the full 46-ft. depth of the entrance slot. Operation of this gate can control the velocity range from 6 to 11 fps. On each baffle are vertical gates 3 ft. wide extending up 13 ft. from the bottom which, when fully open, increase the flow through the fishway by 50 percent. The baffle gates have a dual function in that they can also be used as scavenging ports for sluicing out deposited bed load material. Finally, to provide for closing off the flow into each fishway, a butterfly gate has been specified for the upper end. These gates will be 40 ft. in depth and 5 ft. 10 in. wide.

In 1909, prior to the slide at Hell's Gate, more than 5,000,000 fish spawned in the upper reaches of the Fraser. It is estimated that with the runs restored, 8,000,000 spawning fish may use the Hell's Gate fishways. In a maximum year as many as 200,000 may have to pass through these fishways in a single day. Although only one sockeye salmon run has occurred since the fishways were completed, preliminary tests made by means of tagging salmon have indicated that operation of the structures will be completely satisfactory.

In addition to the Hell's Gate fishways the commission has some 36 other projects of various size to be carried out on the Fraser River. One of these, already finished at Bridge River Rapids, uses much the same general plan developed for Hell's Gate. At Bridge River, however, icing conditions are encountered and because of the danger of ice forming between vertical baffles such as might cause structural damage, the structural design of the baffles was modified to minimize any such effect. Each baffle is in effect a pair of columns with grooves in the facing edge suitable for concrete slabs 2⅝-in. thick that can be lowered into the groove like stop logs, thus any pressure of ice sufficient to break the web of the baffles causes local damage only, which can be easily repaired. The two vertical columns are bonded at the top into a concrete beam. Fig. 3 shows the thin removable web in baffles of the Bridge River structure. The baffles at Hell's Gate are similar except that the web is cast monolithic with the columns.

The success of the project in Hell's Gate comes as a culmination of five years of biological and three years of engineering study of the problem, which has been carried on under the direction of the International Pacific Salmon Fisheries Commission, Milo C. Bell, chief engineer. On work with the hydraulic model Prof. C. W. Harris, University of Washington, served as hydraulic consultant and E. S. Pretious, University of British Columbia, was retained to construct and operate the model.

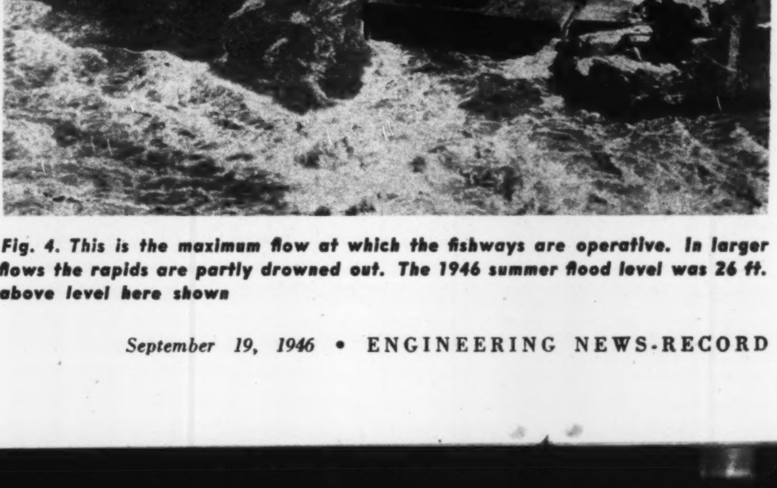


Fig. 4. This is the maximum flow at which the fishways are operative. In larger flows the rapids are partly drowned out. The 1946 summer flood level was 26 ft. above level here shown

Early in their trip the sections crossed the Colorado River on top of Boulder Dam

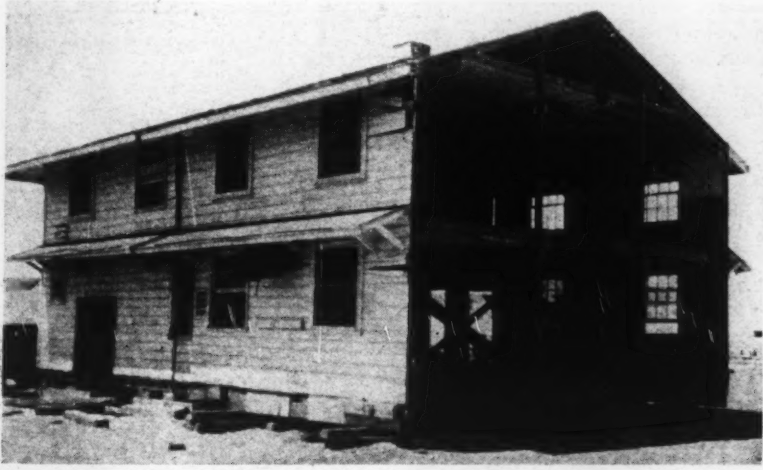
Old Barracks Moved 102 Miles Because of Materials Scarcity

TEN surplus 63-man Army barrack buildings from Camp Willeston near Boulder City, Nev., were recently moved 102 miles by truck. While the move was expensive it was justified by the present shortage of building materials because it made possible speedy completion of facilities for housing workmen at Davis Dam, where the Utah Construction Co. is experiencing many handicaps. Each of the ten buildings is used to house 48 occupants. Nine are used for workmen and male office help and one for female office workers.

The buildings were sawed into four parts for the trip. Each part was 20x30 ft. in plan and two stories high (about 24 ft. from floor joists to the roof ridge board). Fortunately, the route between Boulder City and Davis Dam had no bridges to be crossed, and in only a few places was it necessary to raise telephone or power wires that crossed the highway. Early in the trip the buildings crossed the top of Boulder Dam.

To prevent wracking, the sections were made ready for the trip by being strengthened temporarily by the use of diagonal ties consisting of half-inch steel cable. A pair of such ties was put in at each of the open section ends. The two cables ran diagonally from corner to corner in a vertical plane and each had a turnbuckle for adjusting tension. Without these ties it is believed that the sections could not have been transported successfully over a long and sometimes rough route.

At the new location, concrete foundations were prepared in advance and the sections were set in place and carefully leveled. After the edges of the joints were brought together they were patched and painted over so that on the sides and roof very little evidence of the separation remained. After the installation of new stairways, new washrooms and partitions, the interior was repainted so that the buildings are very suitable for living quarters. Partitions were installed to create 24 rooms, each to be occupied by two persons. Additional features installed at the new location were two large size desert air coolers, one for each floor, which have a capacity sufficient to change the air in the building once every two minutes.



Two of the four 20 x 30-ft. sections into which each of the Army barracks was cut before making a long truck trip.

War Time Plastics Continue to be Used

Two plastic substitutes, adopted by Veterans Administration hospitals during the war because of metal shortages, have proved so useful that they will continue to be used in VA's hospital construction program, it is announced.

Plastic materials will be used for swinging door plates and knobs, previously made of bronze and stainless steel.

Armor plates, push plates and kick plates for swinging doors will be of a sturdy, black plastic that scratches only slightly. They are used for the following purposes:

Placed on lower sections of swinging doors used by wheelchair patients, who can pass through merely by pushing the doors open with their chairs. Push plates are placed so that doors may be pushed open by hand. Kick plates are attached near the floor so that doors may be kicked open.

Door knobs will be made of a tough plastic that may be obtained in several colors. It resists scratches to a greater extent than bronze.

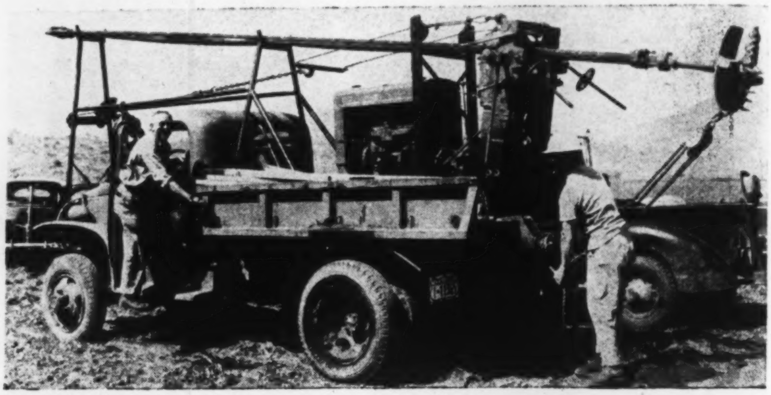
From Field and Office

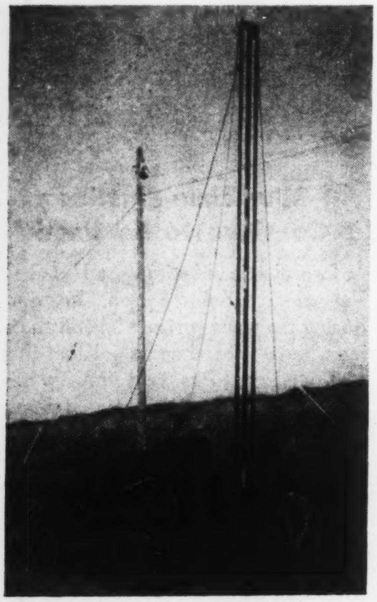
WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Drill Rig Modification Speeds Canal Project

Exploratory work for the Friant-Kern Canal project of the Bureau of Reclamation has been expedited by modification of a drill rig as shown by the accompanying pictures to make it more portable.

Before construction of the structures along the route of the canal could be started, soil samples at various depths at each of the sites had to be obtained. No portable drill could be purchased and the only available rig was that illustrated, but the transportation of this unit was restricted because of the height of the tower. The outcome was alteration of the drill machine to permit the tower to be lowered as shown.


To lower the tower the two bolts passing through the frame at either side are removed and the drill rig is rotated about the hinge shown at the back of the truck.


Drilling was speeded by modifying this drill rig to permit the tower to be lowered for speedy transportation.

Power to shift the position of the tower is obtained from a winch on the front end of the truck, which was purchased from the surplus equipment released by the War Department. Less than five minutes is required to lower or raise the tower.

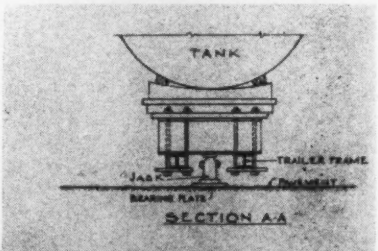
In lowering the tower, two bolts in each of two channel iron members of the frame are removed, the throttle rod is disconnected by removing a small pin, and the three bolts in the flexible coupling are removed. The hinge pins are above the coupling.

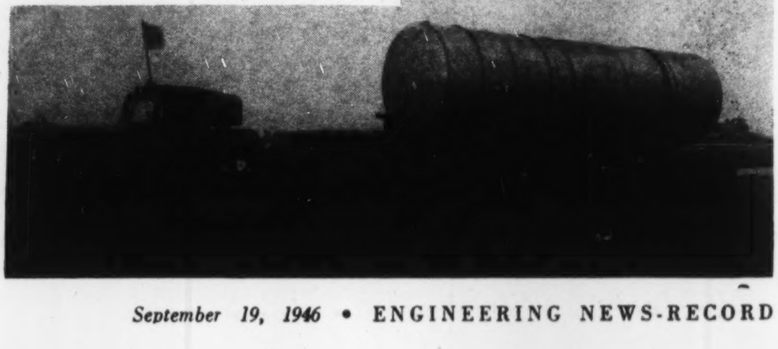
The rig is being used under the general direction of R. K. Durant, construction engineer, Region 2, of the bureau. By drilling holes approximately 24 in. in diameter, a geologist can enter on a rope ladder and examine the material in place.

Movable Load for Soil Testing

For testing soils and foundations at Philadelphia airports, Elwyn E. Seeley & Co. of New York used a water-filled tank and the load of the trailer to provide a 100-ton reaction for a hydraulic jack. In simulation of a plane wheel a 30 in. dia. steel plate, with a bearing area of about 700 sq.in., or the equivalent of the largest current tires, was used. This plate was adopted for the field bearing test for the determination of the modulus of subgrade reaction, which is the K value of Westergaard's formula for the design of rigid pavements.

The tank is supported on the trailer by cradles built up of I beams; a 26-in. beam is clamped to the trailer beam located so that the entire load is balanced at the jack location.





Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Famous Military Bridges

Sir—In reply to your inquiry about the Bailey bridges built by the 1306 Engineer General Service Regiment of whose 1st Battalion I was the commanding officer, I am glad to supply two pictures and the following information. The 190-ft. double-triple Bailey across the Moselle at Thionville, France, has been claimed to be the longest single span built in Europe, while the 2,320-ft. Bailey across the Rhine at Budenheim, Germany was said to be the longest bridge of this type erected in that theater.

Preparatory to the crossing of the Moselle River and the encirclement of Metz, the 1st Battalion, 1306th Engineers, was assigned the mission of constructing a Bailey Bridge at Thionville as soon as the far shore was cleared of the enemy, and then to construct a 2-way Class 70 timber trestle bridge at this location.

On 9 November 1944 the assault of the Moselle was made, and on the night of the 10-11th the bridge materials were successfully moved to the site. Study of a vertical aerial photograph of the site indicated a 160-ft. gap in a masonry arch bridge which otherwise appeared intact. Limited view of this bridge was also obtained from windows of nearby buildings. A 180-ft. double-triple Bailey bridge was planned.

At dawn on the 12th an attack by a battalion of infantry, supported by two companies of combat engineers was made across the river at Thionville to clear the pill boxes and fort on the far shore in order that this Bailey could be built. The bridge was started about noon.

A party under Lt. Miles crossed the river by assault boat and, although completely exposed, swept the approach road and bridge for mines and started constructing the far shore abutment. Shortly after the arrival of the far shore party a line was gotten across the gap and we found the scaled 160 ft. actually to measure 206 feet! What to do? A hurried consultation was held and the far shore abutment was moved 8 ft. in from the center of the pier. The near shore abutment was moved 8 ft. out over the embankment. This required a 190-ft. bridge and heavy shoring of the base plates. Meanwhile the bridge was being built in the street approximately 200 ft. from the near shore where it was partly protected by buildings.

During the early evening a mortar barrage inflicted 17 casualties but, after a hot supper and reorganization, work continued throughout the night and through the 13th of November under cover of a smoke screen. During this time the infantry succeeded in mopping up the pill boxes and fort.

When completed except for the floor, the bridge weighed 110 tons, and was moved on a series of rollers to the site and launched by two bulldozers. After being jacked down on the base plates, a Class 70 floor was placed, and the bridge opened to traffic at dawn on the 14th of November.

The Bailey Bridge was constructed by the 1st Battalion, 1306th Engineers with the major portion of the work being performed by Company C under Capt. McCarthy, supported by Company B under Capt. Williams and elements from Company A, Company E of the 2nd Battalion, Headquarters and Service Company, the attached 609th Engineer Light Equipment Company, and the attached 572nd Engineer Dump Truck Company.

Work was immediately started by Company B on an intermediate pier with the purpose of converting this bridge to Class 70. The intermediate pier was completed on November 25th and the bridge was opened to Class 70 traffic on that date.

At the same time construction was under way by Company B on our primary mission of building a two-way Class 70 timber trestle bridge. This was accomplished by constructing a diagonal section of bridge on pile bents from the end of the stone masonry arch bridge to the undemolished section of a German-constructed steel and timber bridge immediately downstream. The fixed bridge was completed and opened to traffic on 9 December 1944.

Regarding the bridge across the Rhine at Budenheim, a suburb of Mainz, it had a total length of 2,320 ft., three spans being triple-single and the remainder double-single. There were two floating sections each of 70

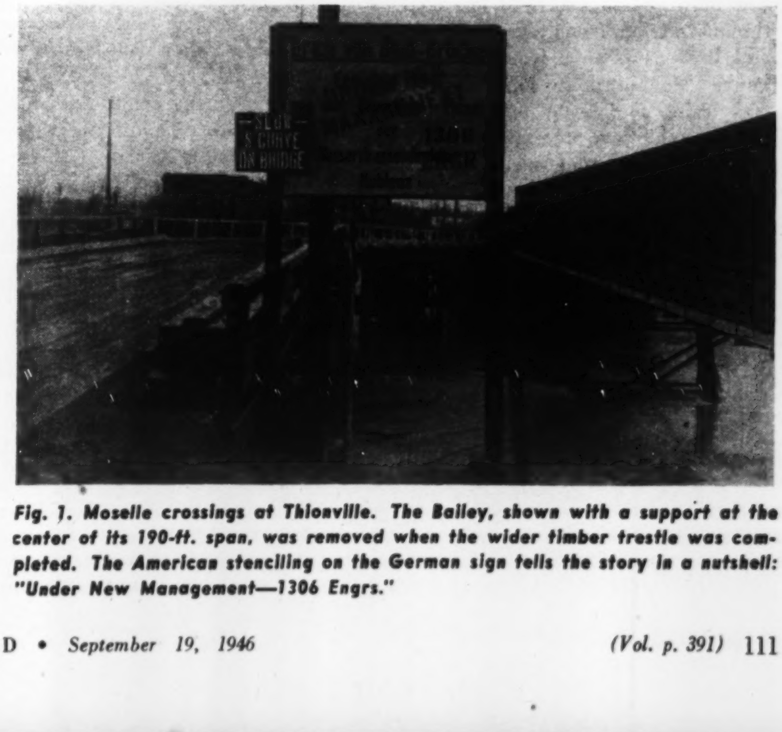


Fig. 1. Moselle crossings at Thionville. The Bailey, shown with a support at the center of its 190-ft. span, was removed when the wider timber trestle was completed. The American stenciling on the German sign tells the story in a nutshell: "Under New Management—1306 Engrs."

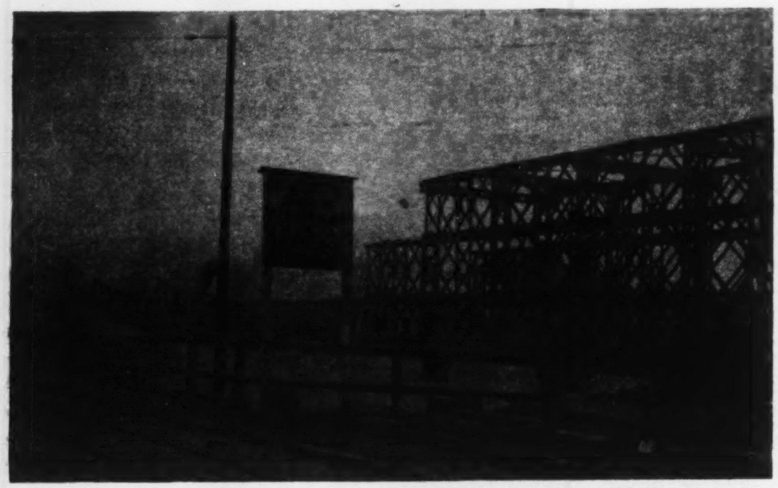


Fig. 2. Launching the 190 ft. Bailey span at Thionville under cover of a smoke screen while the infantry were "mopping up" pill boxes on the far shore.

ft., supported by commercial pontoons salvaged from a floating dock in Mainz Harbor, with two 110-ft. hinge spans from the fixed to the floating sections of the bridge. The floating sections could be detached and floated free to permit river traffic to pass.

The bridge was built by the 1306th Engineers between March 28th and April 12th by utilizing a German military timber pile bridge, which had been completely burned to the waterline. The burned piles were sawed off at or below the waterline by air-driven chain saws. Double timber bent piers were then built on these piles.

One notable feature of this project was that 1,540 ft. of Bailey bridge was built and launched in one continuous section from the east bank, and likewise 550 ft. from the west bank. Moving these long sections was quite a delicate operation to prevent sideway movement which would result from lateral buckling.

ROBERT C. HORNE
Bethesda, Md.

Editor's Note—In March, 1945, an *ENR* editor crossed the Moselle at Thionville on the trestle bridge without being aware that it was the successor to a 190-ft. span Bailey. Subsequently this fact was revealed in correspondence on another matter with E. N. Roberts, engineer for the New Hampshire Public Service Commission who was a construction foreman sergeant in the 1306th Engineers. The above letter resulted from additional correspondence.

No Shortage of Engineers

Sir: In reference to the news item in your issue of Aug. 15, vol. p. 208, concerning the shortage of engineers in North Carolina and Arkansas.

I can safely state that there is no shortage of engineering personnel for field or office existing in this country.

It is unfortunate for us that contractors and consultants do not want the expense of holding their engineers from one job to the next. These layoffs are hard on the families of engineers because their wages (usually higher than that of waterboy) cannot tide them over to the next job. They are forced to seek other work. Many never leave their new jobs, usually because their trained minds are appreciated by their new employers.

Many contractors have shrewd business minds; they can "get engineers a dime a dozen." Engineers are considered by many contractors, yes and by consulting engineers, as excess baggage and overhead. Can any construction job get along without the skill of an engineer?

Responsibilities heaped upon the shoulders of America's engineers exceed by far the ridiculous wages paid them. Common labor, in many instances is better compensated. It is really a joke don't you think?

The engineer is too proud to join a union. Therefore he has but one alternative, give up his profession and enter a new field. I have done so, and so have many of my personal friends —all good engineers.

CHRISTOPHER KRETTECOS
Alameda, California

On Culvert Design Research

Sir: In the article "Reducing Unknowns in Small Culvert Design" (*ENR* July 11, vol. p. 51) F. T. Mavis describes clearly a method of obtaining runoff data from small drainage areas by using highway culverts as controls for the installation of stage recorders. He presents a scale for computing flow through a pipe culvert discharging partly full with a free outlet, which is the simplest case for analysis. Cases where the headwater elevation is affected by the tailwater elevation are more difficult. This is demonstrated in "The Hydraulics of Culverts" (Penna. State Coll. Engr. Exp. Sta. *Bull. No. 56*), in which is published the experimental data used in preparing the rating scale. This bulletin covers the case of the pipe culvert discharging partly full with adequate entrance control, but there are no similar data for the box culverts used on small drainage areas.

It is hoped that the article will stimulate interest in application of the excellent method described. Serious study of the hydraulic problems involved will reveal the necessity of intensive hydraulic model investigations to cover operation of culverts where tailwater must be considered. Hydraulic design of culverts is attaining greater economic importance with the extension of express highways through urban areas, since damage resulting from excessive backwater is far greater there than in rural areas. Hydraulic analysis will show how to keep the headwater elevation down with a minimum cost for culverts.

C. F. IZZARD
Senior Highway Engineer
Public Roads Admin., Washington, D. C.

Correction

Sir: In the item on "Simplified Earthwork Computation" (*ENR* June 27, vol. p. 1004) kindly note the following typographical error: Paragraph 2 states, "Based on the fact that 2 sq. ft. of double end area requires 54 lin. ft. of section for each cubic yard of volume . . ." This should read, "Based on the fact that *each* square foot of double end area requires 54 lin. ft. of section for each cubic yard of volume . . ."—CHARLES F. PARKER, *Chief Engineer, W. H. Hinman, Inc., North Anson, Me.*

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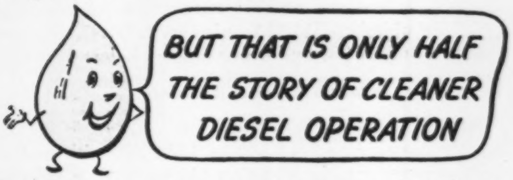
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SHELL DIESEL FUELS AND LUBRICANTS

UNIT PRICES BID BY CONTRACTORS

Airport Improvements Toledo Municipal Airport, Ohio

OWNER: City of Toledo, Ohio, Clayton L. Piper, City Engineer; Forster, Wernert, and Taylor Assoc. Engrs. and Arch.

PROJECT: Improvements to airport near Moline, Ohio, 6 miles east of Toledo. Work consists of a) construction of one and two-story brick and glass block airport terminal building, 270 ft. by 52 ft. b) moving east hangar, a concrete block structure, 400 ft. straight and then 150 straight in an "L" movement; moving power substation of brick and masonry construction, 300 ft. straight; and moving frame Grange building 600 ft. straight and then 200 ft. laterally across highway c) grading, paving, installing drainage, water, and sanitary sewerage system.

CONDITIONS: Specifications provided an option for bid proposals to be based on prices of labor and materials as of July 16, 1946. Where this option was selected, bidder submitted bid price for labor and material and net costs of materials and rate of wages which he expected to pay. In the event of an unanticipated increase in cost of materials or prevailing wages, the City of Toledo will pay the contractor the increased net cost. There is no specified contract time for the airport terminal building. Contract time for moving the three structures is 120 days. Grading, paving, drainage, etc., work was to be started August 1 and completed December 31, 1946. Contract, however, was not awarded by August 1, 1946. Although rail facilities are 2 miles away, state highways go directly to the job site. Prevailing wage rates per hour are: common labor, $1.125; sewer diggers above 6 ft., $1.41; glaziers, $1.50; painters, $1.675; roofers, $1.725; carpenters, $1.75; steamfitters, $1.875; plumbers, $1.875; plasterers, $1.975; masons, $2.00; electricians, $2.00; and sewer diggers below 6 ft. $2.25.

Airport Terminal Building

BIDS: Three lump sum bids were received July 16, 1946, ranging from the low bid of $308,130 to $322,000, with amounts quoted for sub-trades and unit prices bid for work to be added to or deleted from contract.

LIST OF BIDDERS:

1. Herman J. Suhrbier, Toledo, Ohio	$308,130
2. John Naumann & Sons, Inc., Toledo, Ohio	319,463
3. Comte Construction Co., Toledo, Ohio	322,000

Item	Unit Added	Unit Deleted	Unit Prices		
			(1)	(2)	(3)
1. Plumbing-subtrade	.....	.....	$10,540	$11,067	$11,200
2. Heating and ventilating-subtrade	.....	.....	32,495	34,120	35,200
3. Lighting and power wiring-subtrade	.....	.....	12,333	12,950	13,200
4. Lighting fixtures-subtrade	.....	.....	8,830	9,272	9,500
5. Excavation below elevation 617.0	cu. yd.	.....	5.00	5.00	3.00
6. Excavation below elevation 617.0	.....	cu. yd.	1.00	3.50	2.00
7. Excavation to elevaticn 617.0	cu. yd.	.....	3.50	4.00	2.50
8. Excavation to elevation 617.0	.....	cu. yd.	1.00	3.00	2.00
9. Forms	sq. ft.	.....	.65	.46	.70
10. Forms	.....	sq. ft.	.25	.40	.60
11. Concrete	cu. yd.	.....	15.00	15.00	16.00
12. Concrete	.....	cy. yd.	9.00	10.00	14.50
13. Steel reinforcement (incl. setting)	lb.	.....	.10	.08	.08
14. Steel reinforcement (incl. setting)	.....	lb.	.04	.05	.07

Moving Three Structures

BIDS: Only one bid was received July 16 for this job. Bid in the amount of $90,685 from E. W. La Plante Co., Indianapolis, Ind. was itemized as follows:

Item	Amount
1. Moving east hangar, a concrete block bldg., 400 ft. straight and 150 ft. straight in an "L" movement (bldg. 80′ x 100′ x 30′)	$48,480
2. Moving power substation of brick and masonry construction, 300 ft. straight (3-story bldg. 22′ x 38′)	8,640
3. Moving frame Grange building 600 ft. straight and then 200 ft. laterally across highway (bldg. 102.7′ long, 52.7′ on south side, and 69.6′ on north side)	33,565

Grading, Paving, Drainage, Water and Sewerage System

BIDS: Only one bid, in the amount of $424,733.88, was received July 16 for this work. The bidder, Pierce Construction Co., Toledo, Ohio, chose the option of basing his bid on the cost of labor and materials.

Item	Quantity	Unit Prices	
		Labor	Materials
E-1 Grading, unclassified, incl. for drainage	29,770 cu. yd.	$1.00	....
T-71 Loading apron, 150 ft., 8″ cl. C reinf. concr	12,128 sq. yd.	1.60	$2.15
T-71 Taxiways, 50 ft., 8″ cl. C. reinf. concr	35,652 sq. yd.	1.35	2.15
T-71 Taxiways, 25 ft., 7″, 5″ cl. C. reinf. concr	5,104 sq. yd.	1.70	1.50
T-71 Entrance driveway, 36 ft., 8″ cl. C. reinf. concr.	6,952 sq. yd.	1.75	2.15
I-13 Concr. walks, 6″ cl. C, in front of adminsitration bldg	16,695 sq. ft.	.33	.17
T-35 Asph. conc. wearing surf., 3″, on 20 ft. driveway	170 tons	2.00	4.00
T-35 Asph. concr. wearing surf., 2″, on auto parking strips	2,678 tons	2.00	4.00
B-20 Water bound macadam base, 5″, for 20 ft. driveway and auto parking strips	19,775 sq. yd.	.75	1.00
T-71 Hangar apron, 8″ cl. C reinf. concr	1,728 sq. yd.	1.75	2.15
I-12 Concr. curbs, 6″x16″ cl. C	188 lin. ft.	.75	.75
I-12 Chainlink wire fence incl. gates, 48″, and pipe posts set in concr	535 lin. ft.	.70	.90
I-2 Reinf. concr. sewer pipe, 15″	380 lin. ft.	1.34	1.50
I-2 Plain concr. sewer pipe, 15″	1,460 lin. ft.	1.59	.75
I-2 Reinf. concr. sewer pipe, 12″	2,150 lin. ft.	1.25	1.10
I-2 Plain concr. sewer pipe, 12″	1,842 lin. ft.	1.49	.45
I-2 Reinf. concr. sewer pipe, 10″	542 lin. ft.	1.23	.95
I-4 Downspout drainage vit. pipe, 8″	132 lin. ft.	1.39	.50
I-4 Downspout connections vit. pipe, 6″	182 lin. ft.	1.35	.40
I-8 Special double catch basins	5 each	85.00	90.00
I-8 Special catch basins	37 each	52.00	60.00
I-8 Special brick manholes, 63 lin. ft	9 each	65.00	60.00
I-8 Reset tops existing catch basins to new grade	5 each	20.00	....
I-3 Corr. metal perf. drain pipe, 6″	15,494 lin. ft.	.84	.75
I-3 Soft tile road driange, 6″	6,280 lin. ft.	.84	.75
I-9 Stone (#7) placed in backfill	790 tons	2.10	1.00
I-9 Stone (#46) backfill laterals french drains	3,970 tons	2.35	1.00
I-9 Install water system compl. with pump, tank, controls, fittings and piping (less deep well and casing)	1	7,000.00	8,000.00
I-9 Install sanitary sewer system compl	1	11,000.00	7,000.00
I-9 Ditch and backfilling for power cables, incl. plank and sand cushion	1,900 lin. ft.	.35	.15
I-9 Three conductor high voltage cables (7200 v.)	1,500 lin. ft.	.30	1.70
I-9 Single conductor low voltage cable (600 v.)	3,200 lin. ft.	.05	.15
I-9 150 KVA transformer compl. with gas absorber and std. accessories	1	137.50	2,455.55
I-9 15 KV potheads compl	5 each	27.00	75.00
I-9 2-pole contractor	1	11.00	24.83
I-9 Cl. C concr. apron light posts	10 each	55.00	20.00
I-9 Cl. C concr. telephone box support posts	5 each	55.00	20.00

Warehouse Building at Hungry Horse Government Camp, Kalispell, Mont.

OWNER: BUREAU of Reclamation, Hungry Horse Project, Montana, Mr. Paul A. Jones, Project Engineer.

PROJECT: Construction of warehouse building consisting of storage section "A", 60′x120′, height to be 14′ to the bottom chords of the roof trusses and separated from sections "B" and "C" by a concrete fire wall; crane storage section "B", 40′x260′; height 27′ to bottom chords of roof trusses, with rear side open to section "C"; shed storage section "C",

Warehouse Building at Hungry Horse Government Camp, Kalispell, Mont.

Continued from preceding page

30'x200'. Foundations of all sections and outside walls to a height of 4 ft. will be concrete. Framework above concrete walls will be structural steel covered with corrugated steel sheets. A 10-ton travelling crane will be installed in section "B".

CONDITIONS: Government will furnish 10-ton crane, all structural steel framing, sheet metal, including corrugated siding and roofing, metal windows and doors, metal jambs and heads to be embedded in concrete, cement for use in concrete and grout, field rivets, roof ventilators, safety flues, and unit heaters. Materials so furnished will be delivered to the contractor F.O.B. cars at Columbia Falls, Montana, and hauled by contractor to job site, approximately 8 miles east of Columbia Falls. Contract time, 150 calendar days. Wage rates as follows: common laborers, $.90, carpenters, $1.38, cement finishers, $1.50, electricians, $1.45, plumbers, $1.375, roofers, $1.25, sheet metal workers, $1.25, and truck drivers, $.95 to $1.50.

BIDS: Five bids were received May 28, 1946, ranging from $91,288.00 to $131,389.00.

LIST OF BIDDERS:

1. Dudley Const. Co., Great Falls, Mont.	$91,288.00
2. Montana Engrg. & Const. Co., Helena, Mont.	104,620.00
3. Fred R. Comb Co., Minneapolis, Minn.	123,150.00
4. Midland Constructors, Inc., Chicago, Ili.	130,000.00
5. Askvold Const. Co., Inc., Great Falls, Mont.	131,389.00

Item	Quantity	Unit Prices (1)	(2)	(3)
1. Excavation	1,500 cu. yd.	$2.50	$2.50	$3.00
2. Compacted backfill	2,500 cu. yd.	2.25	4.00	3.00
3. Concrete, except in floors	740 cu. yd.	32.00	40.00	45.00
4. Concrete in floors	455 cu. yd.	20.00	35.00	25.00
5. Furnishing and placing reinforcement bars and fabric	101,000 lbs.	.11	.12	.10
6. Furnishing and placing pea-gravel fill	2,700 sq. yd.	.40	.50	1.25
7. Erecting steel warehouse	lump sum	36,943.00	31,875.00	53,000.00

Schooner Creek Bridge, Lincoln County, Oregon

OWNER: Public Roads Administration, Dist. 1, Portland, Oregon, W. H. Lynch, Div. Engr.

PROJECT: Continuous concrete T-beam design bridge of two 70 ft. and two 57½ ft. spans with a 15 ft. cantilever span at each end. Bridge to be 286 ft. long, 26 ft. wide, with 2-4 ft. sidewalks. Approach grading of 1.749 mi. and surfacing of 2.040 mi.

CONDITIONS: Transportation by Oregon Coast Highway. Contract time, 210 calendar days. Skilled wage rates, $2.15 per hr. and common wage rates, $1.15 per hr.

BIDS: Only two bids were received May 22, 1946 at Portland, Ore. resulting in the subsequent award of the contract for $92,080.20.

LIST OF BIDDERS:

1. C. J. Eldon, Portland, Ore. (contract)	$92,080.20
2. Lookyear & White, Inc., Seattle, Wash.	99,915.00

Item	Quantity	Unit Prices (1)	(2)
1. Extra & misc. force account work	All reqd.	$250.00	$250.00
2. Unclassified excavation for structures	600 cu. yds.	16.00	10.00
3. Concrete class A	1,100 cu. yds.	48.00	54.00
4. Concrete class S	237 cu. yds.	30.00	54.00
5. Reinforcing steel	159,000 lbs.	.085	.08
6. Structural steel, furn., fabr. & erected	9,500 lbs.	.40	.40
7. Steel handrail	582 lin. ft.	8.60	8.50

Bituminous Concrete Road, Brewer, Maine

OWNER: State Highway Commission, Augusta, Maine, Lucius D. Barrow, Chief Engineer.

PROJECT: Removing old concrete pavement and bituminous patches, and laying new bituminous concrete road, 1.13 miles long at Brewer, Maine.

CONDITIONS: All materials to be furnished by contractor. Contract time is 125 calendar days. Stipulated minimum wages are $1.00 per hour for skilled labor, $.80 per hour for semi-skilled, and $.66 per hour for common labor. Heavy traffic on this street must be maintained during construction.

BIDS: Three bids were received July 17, 1946 at Brewer, Maine, ranging from the contract low of $154,991.75 to $165,318.00.

LIST OF BIDDERS:

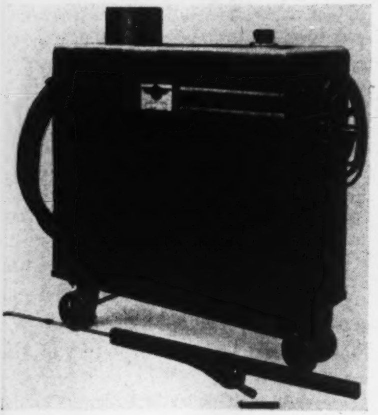
1. Bridge Construction Corp., Augusta, Me. (contract)	$154,991.75
2. Lane Construction Corp., Meriden, Conn.	158,513.80
3. Warren Bros. Roads Co., Cambridge, Mass.	165,318.00

Item	Quantity	Unit Prices (1)	(2)	(3)
12a. Earth excavation	9,000 cu. yd.	$1.15	$1.50	$1.00
12b. Rock excavation	50 cu. yd.	5.00	8.00	15.00
12e. Trees removed	2 ea.	50.00	50.00	50.00
13. Excav. for structures	1,400 cu. yd.	3.25	4.00	2.25
24a. Gravel base course	6,600 cu. yd.	1.20	1.25	1.75
24b. Base outlets	50 cu. yd.	3.50	4.00	2.50
27. Bit. conc. base crse.	182 tons	7.50	7.00	10.00
28a. Levelling mixture	1,621 tons	8.25	8.00	11.00
28b. Removal of bit. patches	600 sq. yd.	0.50	0.75	1.00
29. Cement concrete base	2,700 cu. yd.	15.00	16.00	16.00
30a. Stl. reinf. for conc. base	105,000 lb.	0.10	0.08	0.12
32. Gravel surface course	25 cu. yd.	2.50	4.00	4.00
35a. Bit. gr. surf. crse. (premixed method)	220 cu. yd.	6.00	5.00	5.00
35b. Bituminous material	3,600 gal.	0.25	0.20	0.20
37a. Bit. conc. surf. course	2,640 tons	10.75	10.50	11.00
37b. Tack coat	4,200 gal.	0.16	0.15	0.30
42a. Class "A" concrete	34 cu. yd.	40.00	40.00	30.00
42b. Class "B" concrete	58 cu. yd.	35.00	35.00	30.00
43. Stl. reinf. for conc. structures	5,000 lb.	0.10	0.10	0.10
48a. 8" asph. coated corr. metal pipe	50 lin. ft.	1.50	1.40	1.10
48b. 10" asph. coated corr. metal pipe	50 lin. ft.	1.60	1.70	1.25
48c. 12" asph. coated corr. metal pipe	1,538 lin. ft.	2.00	1.85	1.75
48d. 15" asph. coated corr. metal pipe	78 lin. ft.	2.50	2.25	2.00
50h. 48" reinf. concrete pipe	112 lin. ft.	13.50	13.00	13.50
51e. 15" vitrified clay pipe	50 lin. ft.	2.50	1.65	1.30
51f. 18" vitrified clay pipe	148 lin. ft.	3.50	2.00	1.50
52b. Drop inlet—Type B	1 ea.	125.00	175.00	125.00
52e. Catch basins—Type C	30 ea.	200.00	175.00	100.00
52g. Traps	15 ea.	40.00	25.00	25.00
55a. Underdrain—Type A	50 lin. ft.	2.00	1.75	3.00
55b. Underdrain—Type B	100 lin. ft.	3.00	2.50	3.00
55g. Underdrain outlets	40 lin. ft.	1.50	1.25	1.50
60. Metal sluice	24 lin. ft.	6.00	2.50	5.00
62a. Concrete curb	450 lin. ft.	2.80	2.00	2.50
62b. Integral concrete curb	9,360 lin. ft.	0.85	1.10	1.25
65d. Guard posts	12 ea.	3.00	4.00	1.50
76a. Relocating wire cable gd. rail	410 lin. ft.	0.60	0.50	1.50
76b. Relocating anchorages	4 ea.	12.00	12.00	15.00
77. Relaying 12"-15"-18" C. M. P. & 15" clay pipe	250 lin. ft.	1.50	1.00	1.50
78. Removing old concrete pavement	400 sq. yd.	1.25	1.00	2.50
67b. Loam borrow	450 cu. yd.	5.00	4.00	2.50
68. Sodding	1,750 sq. yd.	1.25	1.25	1.00
69. Project markers	2 ea.	25.00	25.00	20.00
72. Underdrain outlet marker	1 ea.	3.00	7.00	10.00
73. Traffic officers	650 man hrs.	1.25	1.25	1.00
75. Gravel overhaul	17,500 yd. mi.	0,10	0.10	0.10

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Vapor Steam Cleaner—New machine for cleaning road, construction, railroad, marine and other machinery is available as a stationary unit with base or a movable unit with casters or trailer-carrier unit. Two easily accessible valves enable one man to operate machine and pressure, once set, is automatically controlled throughout cleaning operation. There are only four valves on entire machine. System of instantaneous electric ignition enables working pressure of 100 lb. to be rapidly reached, eliminating wait for unit to warm up or need for pre-heating. Cleaner burns No. 1 fuel oil, kerosene or light oil, and can be used with any high-grade cleaning material of standard make. Standard models are equipped with ½-hp., 110 v., 60-cycle A-C. motor and 5-ft. drop cord. The cabinet is 18x43x36 in., overall size 18x48x48 in. and the unit weighs 550 lb. Machine has capacity of 100 gal. per hour.—*White Engineering & Mfg. Co., 66 W. Passaic St., Rochelle Park, N. J.*

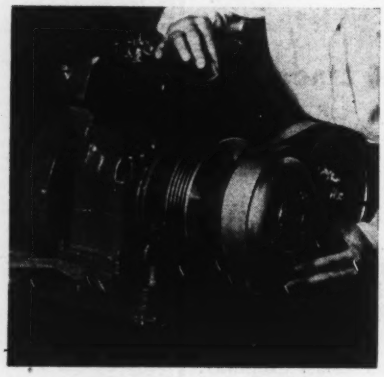


Construction Accounting—Regular accounting sheets for Cash Receipts, Cash Paid Out, Job Records and Payroll Records in looseleaf form, with instructions and a special Contractors and Builders Tax Calendar for handling cost keeping and accounting, are now available. Outstanding feature of these sheets is use of building terms and items in the printed headings of the forms themselves as well as in the instruction sheets. Space is provided for continued checking of estimated costs against actual job costs as well as room for important "Job Memoranda" for future estimates.—*Tallman, Robins & Co., Dept. 29, 314 West Superior St., Chicago 10, Ill.*

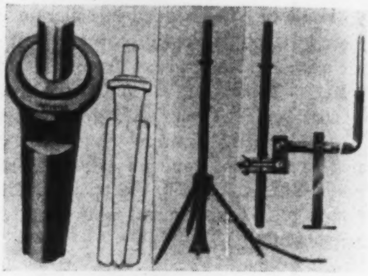
Seismograph for Road Soundings—A portable seismograph that locates rock levels rapidly along a highway location has been developed by Rev. Daniel A. Linehan, chief seismologist of the Jesuit College in western Massachusetts and has been proven practical and economical by use on Massachusetts highways. Weighing only 50 lb. and priced within reach of construction firms and engineers, the device is being manufactured by the *Diamond Instrument Co., Wakefield, Mass.*

Hydraulic Slide Rule—A slide rule and correction factor curves are the media for direct mechanical solution of such factors as water depth, slope, width of channel, discharge quantity, and coefficient of roughness as defined by the Manning or Kutter formulas. Velocity of flow is also obtainable. The slide rule is based on an adaptation of the Manning formula.—*Charles Harry Monett, 300 South Carmelina Ave., Los Angeles 24, Cal.*

Power-Package—The Power-Package consists of a 6 hp. gasoline engine, with automatic clutch and automatic transmission, designed to transmit the engine's power smoothly and at the most advantageous speed, depending on load. It will power light vehicles, or fit almost any stationary use in which a small engine is required. The engine weighs only 56 lb., yet develops 6½ hp. at 3,200 rpm.



This package is suggested for starting gas and diesel engines; and for powering small scrapers, graders, concrete mixers, hoists, winches, etc.—*Salsbury Motors, Inc., Pomona, Calif.*



Rock Tools—The "Boulder Buster" that splits rock, concrete or similar material; a three-legged drill steel guide that helps to prevent foot injuries; and a drill steel ejector that is clamped to stuck steels to loosen them by driving on the opposite end over a fulcrum are now available. The Boulder Buster is inserted in a drill hole and driven into an enlarging wedge either by sledge or pneumatic hammer.—*Universal Pneumatic Tool Co., 722 Chestnut St., St. Louis 1, Mo.*

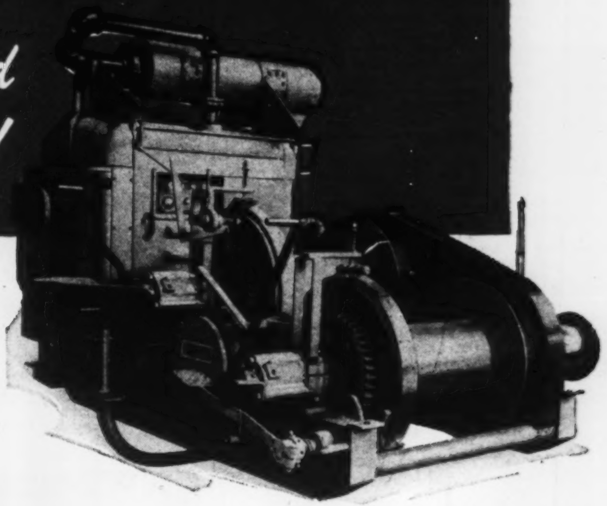
Air-Acetylene Tip—An attachment adapts any standard oxy-acetylene welding torch for soldering, tinning and light brazing with an acetylene-air flame. Acet-A-Tip is attached to the welding torch tip by means of a base, fitted with a 2-in. length of hose, which is forced over the welding torch tip, providing quick, positive attachment. This device is available in three sizes—*Acet-A-Tip Co., 5069 West Madison St., Chicago 44, Ill.*

Booster Cylinder—Using standard diaphragm top, oil-operated hydraulic booster cylinder for air-operated controllers provides high power amplification and permits exact positioning of heavy valves, bin gates, etc., in accordance with applied pneumatic loading pressure.

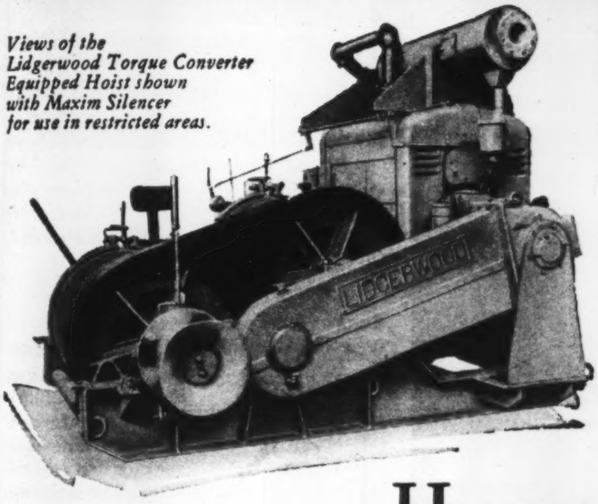
Cylinder may be of crank type or of straight reciprocating type. Straight cylinders are available up to 8-in. bore and 30-in. stroke.—*Askania Regulator Co., 1603 S. Michigan Ave., Chicago, Ill.*

the NEW LIDGERWOOD Torque Converter Equipped Hoist

...Lifts heavy loads and "floats" them into place!



Views of the Lidgerwood Torque Converter Equipped Hoist shown with Maxim Silencer for use in restricted areas.



Here's a new and advanced type hoist that makes light work of many heavy load lifting tasks for industry! It is especially suitable for setting steel in buildings, on bridges, or on many other construction and industrial jobs. Its remarkable flexibility and responsive speed literally "floats" loads into place.

The simplicity of this Lidgerwood Torque Converter Equipped Hoist makes light work of operation, too. For it offers 100% speed and load control by a single lever.

Powered by a husky Diesel or Gasoline engine that cannot stall when under load, this hoist gives you all the smooth, flexible control you've obtained in the past with steam hoists—with the important added advantages of greater economy and lighter weight.

Designed, built and tested by Lidgerwood, this compact hoist is another example of modern design that stems from 72 years of leadership in manufacturing hoisting equipment.

Let this better hoist put your heavy loads on the spot. You may order it built in sizes from 75 H.P. to 150 H.P. or larger.

Principal Features:

- 100 H.P. Diesel Hoist
- Rating 10,000 lb. line pull
- At 210 feet per minute
- All Steel Construction
- Anti-Friction Bearings
- Grouped Levers at Operator's Seat

LIDGERWOOD
ESTABLISHED 1873
Manufacturing Company
149 BROADWAY, NEW YORK 6, N. Y.

Worthington-Ransome Blue Brute Distributors

See ad on page 121 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Montgomery, Burford-Toothaker Tractor Co.
Ala., Birmingham Construction Equip. Co.
Alaska, Anchorage, Airport Mac. & Storage Co.
Ariz., Phoenix, Lee Redman Co.
Cal., San Francisco, Coast Equip. Co.
Cal., Los Angeles, Golden State Equip. Co.
Colo., Denver, Power Equipment Company
Conn., New Haven, Wilhelm-Davies Co., Inc.
Fla., Miami, Allied Equip., Inc.
Fla., Orlando, Highway Equip. & Supply Company
  Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida., Boise, Olson Manufacturing Company
Ill., Chicago, Chicago Construction Equipment Co.
Iowa, Cedar Rapids, McHall Machy. & Supply Co.
Ky., Harlan, Croushoan Equip. & Supply Co.
Maine, Portland, Maine Truck-Tractor Company
Mass., Allston, Boston, Clark-Wilcox Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Minn., Minneapolis, Phillippi-Murphy Equip. Co.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
Montana, Billings, Interstate Truck & Equip. Co.
  Helena, Caird Eng. Works
N. C., Raleigh, Smith Eqt. Co.
N. J., No. Bergen, American Air Compressor Corp.
N. M., Albuquerque, Bud Fisher Co.
N. M., Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Company
  New York, Hodge & Hammond, Inc.
N. Y., Olean, Freeborn Equip. Co.
N. Y., Syracuse, Milton-Hale Mach. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.
O., Cincinnati, Carroll-Edwards Co.
Okla., Oklahoma City, Townsco Equip. Company
Ore., Portland, Andrews Equip. Service
S. C., Columbia, Smith Equipment Company
Tenn., Knoxville, Dempster Bros., Inc.
Tenn., Memphis, Independent Tractor Co.
Tenn., Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Tex., Dallas, Shaw Equip. Co.
Tex., Houston, Contractors Equip. Sales & Service Corp.
Tex., San Antonio, Patten Machy. Co.
Tex., Tyler, D. M. McClure Equipt. Co.
Utah, Salt Lake City, J. K. Wheeler Mach. Co.
Vt., Barre, A. M. Flanders, Inc.
Wash, Spokane, Andrews Equip. Service
Wisc., Milwaukee, Drott Tractor Co. Inc.

Ransome Distributors

D. C., Washington, M. A. Doetsch Mach. Company
Ill., Chicago, Thomas Hoist Company
Ind., Fort Wayne, American Steel Supply Corp.
Ky., Paducah, Henry A. Petter Supply Company
La., New Orleans, Ole K. Olsen Company
Md., Baltimore, Stuart M. Christhilf & Company
Mich., Detroit, T. G. Abrams
Mo., Kansas City, Brown-Strauss Corp.
Neb., Lincoln, Highway Equip. & Supply Co.
N. Y., Buffalo, Murray Equip. Co.
O., Cleveland, H B. Fuller Equip Company
Pa., Philadelphia. Giles & Ransome
  Pittsburgh, Arrow Supply Company

Worthington Distributors

Ark., Fort Smith, R. A. Young & Son
  Little Rock, R. A. Young & Son
Ind., Indianapolis, Reid-Holcomb Company
Ky., Louisville, Williams Tractor Company
La., New Orleans, Wm. F. Surgi Equip. Company
Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
  Flint, Gransden-Hall & Company
Mo., Kansas City, Mach. & Supplies Co.
N. Y., Buffalo, Dow & Co., Inc.
  New York, Air Compressor Rental & Sales
O., Cleveland, Gibson-Stewart Company
  Toledo, The Kilcorse Mach. Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
  Easton, Sears & Bowers
  Harrisburg, American Equip. Corp.
  Oil City, Freeborn Equipment Company
  Pittsburgh, Atlas Equip. Corp.
Pa., Phil. Metalweld, Inc.
  Wilkes-Barre, Ensminger & Company
Texas, El Paso, Equip. Supply Company
Va., Richmond, Highway Mach. & Supply Co.
Wash., Seattle, Star Machinery Company
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

Buy Blue Brutes

Worthington Pump and Machinery Corp.

Worthington-Ransome Construction Equipment Division

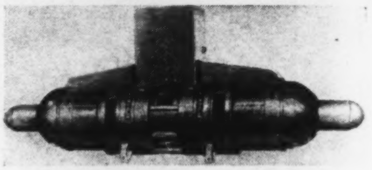
Holyoke, Massachusetts

Prefabricated Steel Building — Featuring a rigid frame design, as compared with truss design, Rigidsteel buildings are stiff-jointed industrial and commercial structures made up of a system of rigidly joined beams. This system eliminates trusses and relegates secondary bracing to building contours. The usual gussets are replaced by compact ridge and eave joints. Calculated lateral stresses on building foundations are to be controlled and normalized in erection.

Rigidsteel construction provides a large area of usable interior head room, easy erection and portability, low maintenance costs and ease of alteration. Each bent for a complete building unit consists of two columns and two rafters. All connections are field bolted. Overhead load equipment can be installed on rafters at any point without structural alteration, it is claimed.—*McCloskey Co., 313 Sixth Ave., Pittsburgh 22, Pa.*

Industrial Safety Equipment —Safety goggles, gloves, mittens, cover-mitt, hand pads, sleevelet, finger cots, spats and ladder shoes are among new equipment available. Goggles include Duraweld goggle for welders; Duralite goggles for eye protection against flying objects; chemical and dust goggles; and Fits-on goggle for protecting spectacle goggle lenses from pitting and scratching. Gloves include open-back type for women who perform light assembly and bench work; all-purpose glove for women workers; heat glove for jobs requiring hot handling; welder's glove; and glove for resisting rough wear on all-purpose jobs. Mittens include heat mitten for drop forging, die casting and bending block work; steel-studded mitten for steel workers; and asbestos mitten for heat-treating operations and for coil tying in steel plants. Cover-mitt fits over gloves and mittens and is designed to add materially to their life while hand pads are designed to wear over cotton or lightweight leather gloves. Leather sleevelet provides arm protection on heavy-duty jobs. Sta-Set finger cots protect both front and back of fingers. Two pairs of spats are designed for foundry and chemical workers. Ladder shoes prevent accidents caused by skidding or creeping ladders.—*American Optical Co., Southbridge, Mass.*

1,200 Ampere Welder — A new welder of 1,200 amperes comprising two 600 ampere generators, close-coupled to an AC induction motor and equipped with complete motor control, is announced for use with the "Lincolnweld" process of automatic metallic shielded arc welding. The unit is of arc welded steel, drip-proof construction and is completely wired. Generators are of the variable voltage type with completely laminated magnetic circuits (frame and pole pieces) and equipped with interpoles.

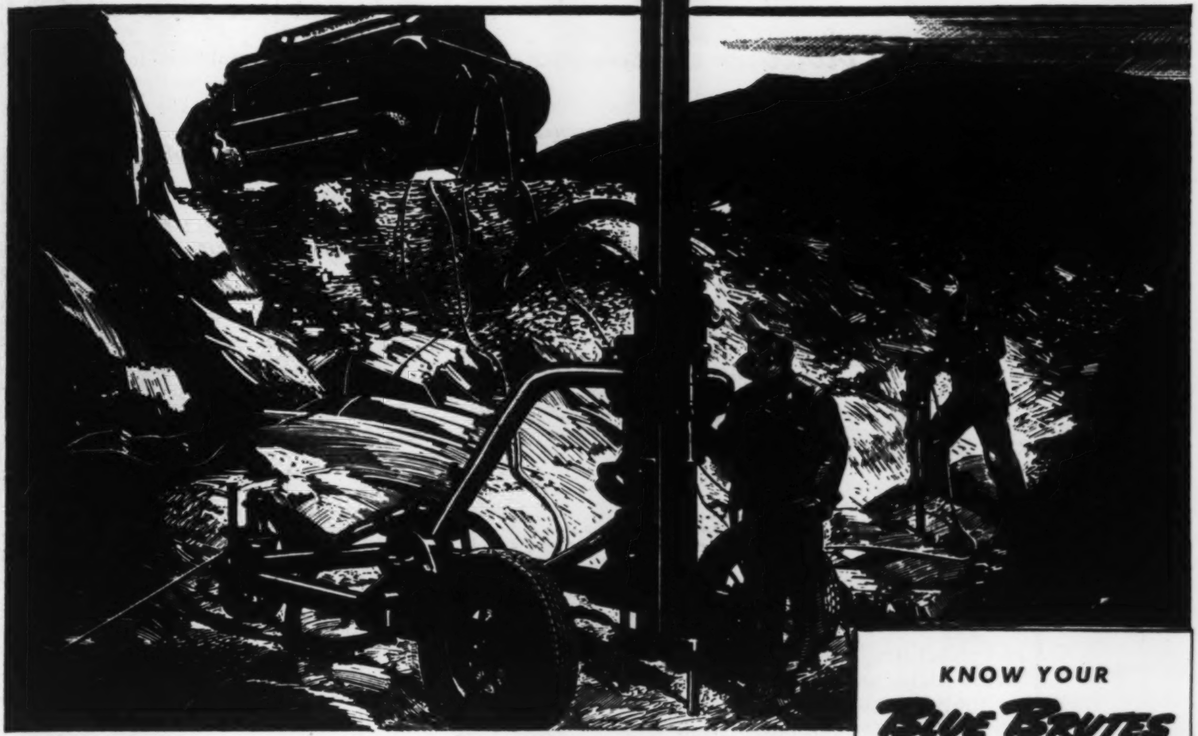


This welder consists of two equally rated generators with their output leads paralleled in the control box by means of copper jumpers between studs of like polarity. The copper jumper on the positive (polarity) side is made removable.—*Lincoln Electric Co., Cleveland, Ohio.*

Bucket Pump Grease Gun —Of all steel construction, the "Porto-Pak" bucket pump grease gun holds 30 lb. of lubricant. It features a positive automatic venting device which instantly operates when the pump handle is raised to the top and permits the lubricant to drain back into the container without dripping. Porto-Pak is of rugged construction and convenient to carry. It has easy, up-and-down pumping action and may be quickly refilled.—*The Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis 20, Mo.*

Fire Fighter — New 750-gal. triple combination fire fighter employs six-cylinder 190 hp. engine, on 160 in. wheel base four-wheel-drive truck. Open-type body of 12-gage steel has large capacity.—*The Four Wheel Drive Auto Co., Clintonville, Wis.*

IT'S A STUBBORN BRUTE — AND THAT'S GOOD!



You can give this Blue Brute 315′ Compressor the toughest jobs on your books and it won't cry for help until you've got your money out of it many times over.

Take, for example, the three-point suspension of engine and compressor in a single housing — it's a Worthington feature that maintains alignment regardless of shock and vibration. Take the Worthington Feather* Valve — it will stay tight-seating and quiet for a lifetime. Take the full force feed lubrication of engine and compressor — it keeps all moving parts in constantly healthy condition. Investigate those vital features!

Teamed up with those versatile Worthington Wagon Drills (that make holes in any direction and at any angle) or other Blue Brute Air Tools, your Blue Brute Compressor will supply *more air* per gallon of fuel — and will stay trouble-free no matter how tough the going.

Make a date with your near-by Worthington distributor so that he can give you the rest of the facts that prove *there's more worth in Worthington.*

*Reg. U. S. Pat. Off.

H6-4

KNOW YOUR

BLUE BRUTES

Your Blue Brute Distributor will gladly show you how Worthington-Ransome Blue Brute construction equipment will put your planning on a profitable basis. His name is listed on page 120. Blue Brutes include:

RANSOME EQUIPMENT

Pavers, Concrete Spreaders and Finishers*, Portable and Stationary Mixers, Pneumatic Placing Equipment, Truck Mixers, Plaster and Bituminous Mixers and accessories.

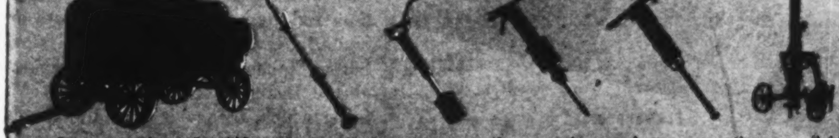
WORTHINGTON EQUIPMENT

Gasoline and Diesel driven Portable Compressors, Rock Drills, Air Tools, Contractors' Pumps* and accessories.

*To be announced

Get more WORTH from air with WORTHINGTON

BUY BLUE BRUTES



Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division
Holyoke, Mass.

Up where trouble threatens . . .

Build in Protection with

WOLMANIZED LUMBER*

On roof structures, where moisture condenses, soaks into every niche and cranny . . . starts rot spots . . . Wolmanized Lumber is needed, badly! Why? Because in this lumber, impregnated with Wolman Salts* preservative by pressure treatment, rot will not set in. Your roof trusses and decks . . . Wolmanized . . . will give you many more years of service where rot-producing moisture is present.

LUMBER with a PLUS!

Wolmanized Lumber gives you all of wood's advantages . . . speed of erection, light weight, resilience, high insulating value, paintability, low first cost . . . long life.

AMERICAN LUMBER & TREATING COMPANY

CREOSOTING

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Men and Jobs

Aaron H. Sullivan, former director and public works and utilities subcommissioner for the Allied Control Commission in Italy, Sicily and Sardinia, has ben appointed regional power manager, Region 5, Bureau of Reclamation, with headquarters at Amarillo, Tex. Before the war, Mr. Sullivan was general office engineer and assistant chief electrical engineer of the Tennessee Valley Authority at Chattanooga. He previously served as chief electrical engineer in charge of design and construction for the Cincinnati Union Terminal Co., Cincinnati, Ohio. A native of Lincoln, Nebraska, Mr. Sullivan attended the University of Nebraska, where he specialized in public utility and industrial engineering management.

Tomas Guardia, chief engineer of the Panama section of the Inter-American Highway, is visting in this country at the invitation of the Institute of Inter-American Affairs. Mr. Guardia is a graduate of the University of Liverpool with degrees in Civil and Mechanical Engineering. He then worked with British engineering firms in Spain for some years and, returning to his own country, served as Chief Engineer of the Central Board of Roads of Panama for ten years. He has been active in road and highway projects throughout Central America, has held various posts with the Ministry of Public Roads of Panama, as well as on construction projects in the Canal Zone, and has represented Panama at various engineering conferences. He first became connected with the Inter-American Highway through the United States Public Roads Administration as associate engineer in charge of construction, and later was made chief engineer of the Panama Section of that highway.

The State of Rio Grande do Sul, Brazil, has sent three high ranking highway engineers to the United States as professional observers. Their selection and journey is in response to an invitation extended through the United States Embassy to Brazil at the request of the Institute of Inter-American Affairs, which agency is providing funds to cover the cost of the trip. The three engineers are: **Darcy Goncalves Teixera**, designing engineer of bridges and pavements; **Edgard Weinmann Pinto**,

THERE'S A *Timken Rock Bit* FOR PRACTICALLY EVERY KIND OF ROCK

The M series; an intermediate bit to the H and D series, designed largely for mining with heavy-duty equipment.

The R series; a bit used in soft formations such as limestone and sandstone.

The D series; a bit used with heavy drilling machines and large section drill steels.

The F series; a sturdy bit designed to achieve fast drilling by virtue of its small gauge.

The H series; a general purpose bit for light and medium weight drills adaptable to any popular hollow drill steel section.

Introduced fourteen years ago, the Timken Rock Bit of today bears a remarkably close resemblance to those on the market in 1932. Improvements have been made—streamlined then, it's more streamlined now; heavy wing sections have become heavier—but basically it's the same design. Fourteen years' experience has confirmed its correctness.

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

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TRADE-MARK REG. U. S. PAT. OFF.
ROCK BITS

"WELCOME . . . . .
Can I be of Service?"

When you're bidding on a job in a strange town, it's a good thing to have an Ætna representative close at hand. And, Ætna *has* representatives from coast to coast—men having a knowledge of local conditions—who are ready and willing to assist you in every way possible.

That's just one of many reasons why hundreds of successful contractors prefer to use Ætna Contract Bonds. They know that at home or away from home, they can rely on experienced Ætna representatives to help them line up new jobs. They know, too, that in any part of the country, Ætna Contract Bonds are readily acceptable in large or small amounts, on public or private jobs.

Get to know the Ætna representative in your community. Let him tell you about Ætna's many *extra* services. We believe you will find him helpful in many ways.

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ÆTNA CASUALTY AND SURETY COMPANY
AFFILIATED WITH ÆTNA LIFE INSURANCE COMPANY
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HARTFORD 15, CONNECTICUT

chief engineer, 4th District; and **Luis Parga Torres**, chief engineer, 9th District.

Herbert G. McCormick, who for 34 years has been building locks and dams in America's rivers, has retired as head engineer of the Rock Island District of the United States Army Engineers having reached the retirement age of 70. He attended the Pratt Military Academy at Staunton, Va., and then spent four years at Virginia Polytechnic Institute. After leaving school he was in construction work for the Norfolk and Western Railroad for six years, after which he spent another year at Virginia Tech., earning a degree in civil engineering. In 1909 he joined the Army Engineers and had been with them ever since, except for a period between 1925 and 1929 when he served as engineer for the United Gas and Improvement Contracting Co. of Philadelphia, building locks and dams on the Ohio. Mr. McCormick was promoted to principal engineer in 1937 and to head engineer, the highest civilian post in the Army Engineer Corps, in 1942. At that time there were only 25 head engineers in the service.

A. E. Williamson, who recently terminated 3½ years of service in the Army Sanitary Corps assigned to the Institute of Inter-American Affairs, is now chief of the sanitary mission for the Unitarian Church Service Committee. He will be in charge of refugee camps in Rome, Italy.

David B. Kirby, of Chambersburg, Pa., has been appointed water works engineer for the Pennsylvania Public Utility Commission.

Sam H. Strickland has resigned as director of public works at High Point, N. C., to enter private business. He was appointed city engineer in 1927 and three years later was made public works director. He was discharged recently after nearly six years of military service.

The William L. Crow Construction Co. has announced the appointment of **Richard T. Geoghegan** as a project superintendent for the New York Life Insurance Co.'s housing development at Princeton, N. J. Mr. Geoghegan is a 1931 graduate of Cornell University School of Engineering. From 1936 until his entrance into the armed forces in 1942 he was associated with the American Bridge Co. He served with the United States Army Corps of Engineers in the Pacific and was discharged in January, 1946, with the rank of major.

Charles P. Disney has retired as bridge engineer, Central Region, Canadian National Railways, after 40 years of continuous railroad service. He joined the bridge engineer's staff of the National Transcontinental Railway at Ottawa in 1906, transferring to the Inter Colonial Railway a Moncton in 1914. After war service with the British Army from 1915 to 1919 Mr. Disney went to Toronto in 1919 as acting bridge engineer. He is succeeded by John F. Salmon who has been his assistant since 1928. Educated in Edinburgh, Scotland, Mr. Salmon joined the Inter Colonial Railway at Moncton in 1913. In 1920 he became chief strucural draftsman with C. N. R. at Toronto, and was appointed designing bridge engineer four years later.

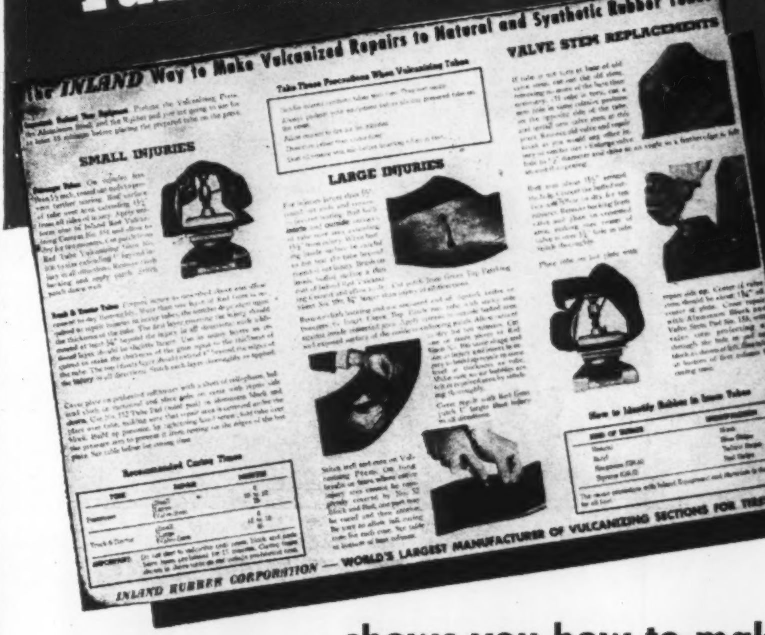
John G. Patrick is a construction foreman for the Iron Mines Co. of Venezuela at San Felix, Venezuela. His previous connections were: Six companies on Boulder Dam; Metropolitan Water District of Los Angeles, on the Colorado River Aqueduct; Mason, Walsh, Atkinson & Kier on Grand Coulee Dam; United States Engineering Dept., Los Angeles district, on the Los Angeles Flood Control, Union Pacific Railroad in Washington State; Walsh & Driscoll, on the Army base in Trinidad, British West Indies.

Colin F. Churchill of Kinston, N. C., has been appointed city manager of Roxboro, N. C., to succeed ***Guy E. Whitman,*** who resigned recently to become public works consultant for the North Carolina League of Municipalities. For the last 13 years Churchill, who received his civil engineering degree from North Carolina State College in 1923, has been with the federal government, serving as traveling engineer of the Public Works Administration in North Carolina and as project manager of housing developments in the state.

Jacob T. Wankmuller has been promoted to assistant district engineer, Federal Works Agency, Bureau of Community Facilities, Division No. 2, for

FREE!

New INLAND Tube Repair Wall Chart


The INLAND Way to Make Vulcanized Repairs to Natural and Synthetic Rubber Tubes

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LARGE INJURIES

VALVE STEM REPLACEMENTS

INLAND RUBBER CORPORATION — WORLD'S LARGEST MANUFACTURER OF VULCANIZING SECTIONS FOR TIRES

—shows you how to make professional repairs to NATURAL or SYNTHETIC rubber tubes

This practical guide shows how to repair all sizes of injuries in all kinds of tubes, step-by-step. How to replace valve stems. How much curing time is required. How to identify various kinds of rubber. Helpful and handy for *everyone* who vulcanizes tubes. See your Inland salesman or automotive jobber for your Free Inland Wall Chart. Or mail the coupon.

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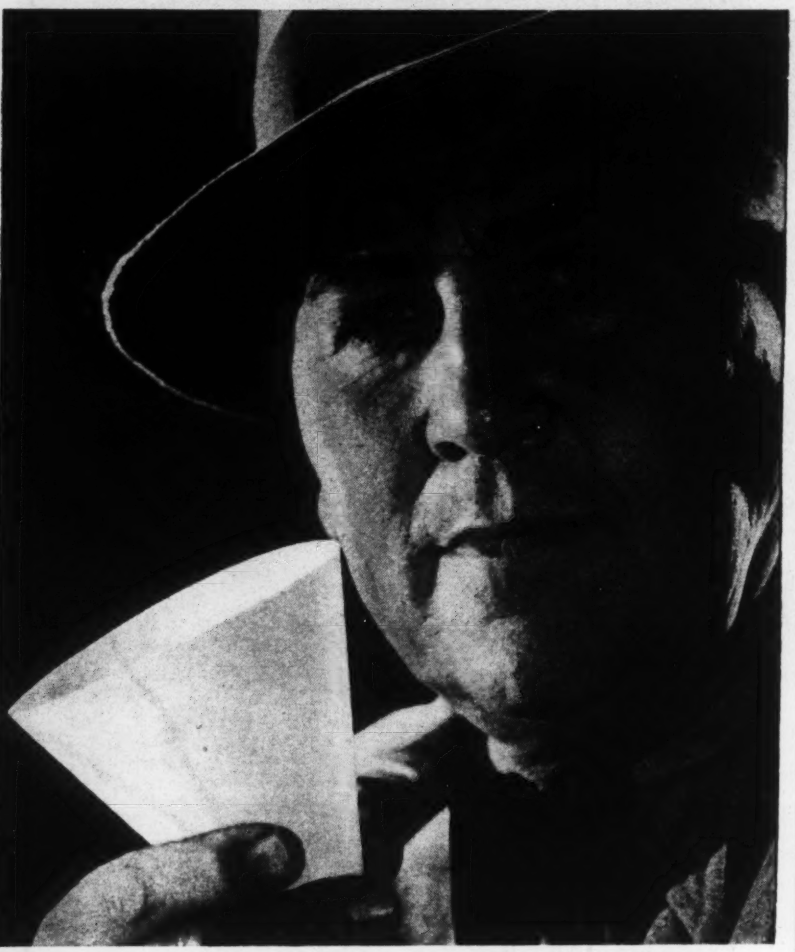
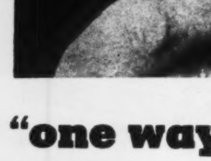


"one way to keep men working . . . reduce absenteeism . . . is with VORTEX CUPS"

Your best bet for checking the spread of colds and other mouth-borne infections — common cause of absenteeism — is individual drinking cups. The Dixie Portable Water Carrier brings individual Dixie and Vortex Cups and cool, clean water right to the men. It helps keep them on the job—helps maintain construction schedules. *Write for descriptive folder.*

DIXIE'S PORTABLE WATER CARRIER



EFFICIENCY HINT: The more nearly water intake offsets sweat loss by men doing manual labor, the better their performance, as shown in report by Harvard University Fatigue Laboratory. Free copy on request.

DIXIE CUPS, VORTEX CUPS AND PAC-KUP CONTAINERS ARE MADE AT EASTON, PA., CHICAGO, ILL., DARLINGTON, S. C., TORONTO, CANADA

the states of Virginia and West Virginia. He will assist the disrict engineer, **R. S. Hummel,** in the administration of the federal programs for postwar planning aid and for the provision of educational facilities for veterans. Previously, Mr. Wankmuller was supervising engineer for the same agency under the War Public Works program (Lanham Act), and had charge of the construction of large water supply projects in the Hampton Roads area of Virginia.

Warren L. King is a chief draftsman in the water and power division of the conservation branch of the Geological Survey, U. S. Department of the Interior at Denver, Colo. In 1941 joined the U. S. Army Engineers in Portland, Ore., and in December, 1942, he transferred to the Area Engineer's Office, Juneau, Alaska, remaining there till March of this year.

Hanen H. Williams, who served as a construction and planning officer for the 102nd Naval Construction Battalion in the Southwest Pacific, has opened an engineering office in Phoenix, Ariz.

T. C. MacNabb, general superintendend of the Canadian Pacific Railway, New Brunswick region, has retired and is succeeded by S. W. Crabbe. Mr. MacNabb was formerly district engineer at Moose Jaw, Sask., and latterly engineer of construction for all lines west of Fort William, Ont.

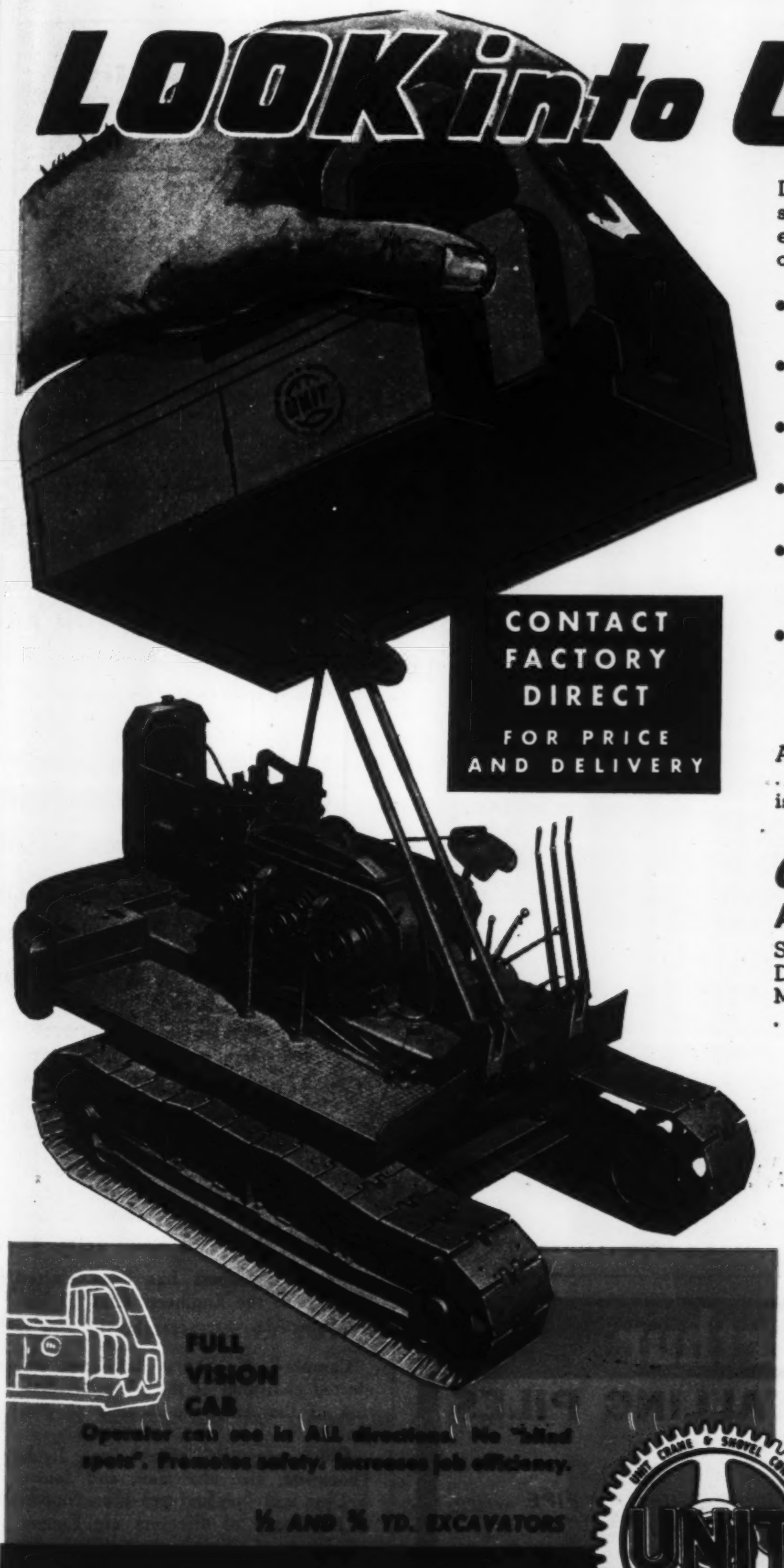
Guy B. Treat, Oklahoma City engineer has been chosen by the state highway commission and the Public Roads Administration to be consulting engineer on city projects there.

Harry H. Kirchmann, of St. Paul, Minn., an authority on heavy construction engineering, has resigned from the Federal Public Housing Authority, to go to Japan for work with the U. S. Army Engineer there. He will have charge of a large construction project.

Emil C. Jensen of Seattle, Wash., has been appointed chief of the public health engineering division, Washington State Department of Health, succeeding **Roy M. Harris,** resigned. A graduate of the University of Washington and of Harvard University graduate school of engineering, he has been head of the state department's sanitary engineering section for the past year and a half.

Lt. Col. William J. Ellison of the Army Corps of Engineers has been assigned to the Portland, Ore., engineer district and will be stationed at Umatilla, Ore.

LOOK into UNIT!


UNIT
FULL VISION CAB
Operator can see in ALL directions. No "blind spots". Promotes safety. Increases job efficiency.
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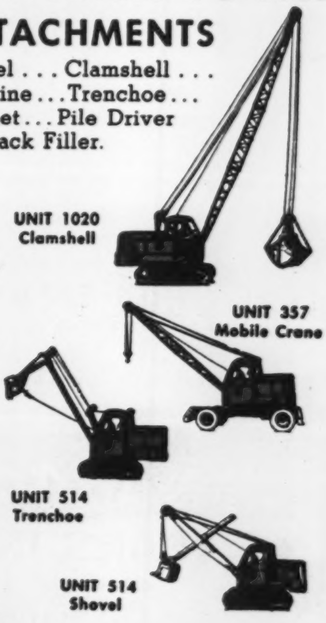
Lift the cab from any UNIT crane or shovel. You'll find the following exclusive features not found in any other comparable machine:

- **Compact, modern design . . . all parts readily accessible.**
- **Gasoline engine mounted in straight line with main machinery.**
- **Drop-forged alloy steel gears and splined shafts, heat-treated.**
- **Automatic traction brakes . . . no manual control required.**
- **Disc type clutches, interchangeable with easy and foolproof adjustment.**
- **One-piece cast gear case...simple in design and built as carefully as the finest automotive transmission . . . dust-proof and oil tight.**

And that isn't all! A UNIT costs less . . . is more economical to operate . . . is built to endure. Investigate today.

Convertible TO ALL ATTACHMENTS

Shovel . . . Clamshell . . .
Dragline . . . Trenchoe . . .
Magnet . . . Pile Driver
. . . Back Filler.


UNIT 1020 Clamshell
UNIT 357 Mobile Crane
UNIT 514 Trenchoe
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5 TO 10 TON CRANES

UNIT CRANE & SHOVEL CORP.

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Model 36
A LOWER-COST, SELF-PROPELLED, PNEUMATIC TIRE MOUNTED TRAVELING MIXING PLANT
★ As MANEUVERABLE as a motor patrol
★ Road SPEEDS 2 to 14 miles per hour
★ ONE MAN operated
★ Handles up to 4 cu. ft. windrows
★ Mixing speeds from 11.5 to 71 feet per minute
★ 100 to 150 tons of mix per hour
★ Ideal for SMALL JOBS with BIG JOB capacity

The Model 36 incorporates all of the proved features of the famous Wood Roadmixers, Models 48 and 54, plus maneuverability, speed and self-propulsion. Ask your local Wood Roadmixer Dealer or write direct to the Wood Manufacturing Company for your copy of Bulletin 36. It gives complete details and specifications on this sensational, self-propelled traveling mixing plant. 2-36

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36 YEARS INSTALLING PILES
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18 EAST 48th STREET, NEW YORK 17, N. Y.
BOSTON • CINCINNATI • NEW ORLEANS

Elections and Activities

The Houston, Tex., Concrete Masonry Products Association has been formed to acquire and exchange practical knowledge among its members; to provide for more efficient co-operation among concrete masonry manufacturers, builders, architects, lending agencies for building officials and others; to create and maintain a standard of manufacturing excellency; to advertise the members' products; to gather technical data and distribute technical literature. The following officers were elected: R. L. Rowan of the Houston Interlocking Tile Company, president; B. M. Craig, first vice-president; G. W. Smith, second vice-president; P. A. Kahle, Jr., secretary; and R. W. Ford, Jr., treasurer.

A state-wide permanent organization of county sanitary engineers in Ohio will be formed soon in Columbus, it was decided, following a recent meeting of sanitary engineers at Cedar Point.

President W. W. Horner of the American Society of Civil Engineers has appointed Alfred T. Glassett, vice-president, W. J. Barney Corp., 101 Park Ave., New York, to serve as the ASCE representative on the executive committee of the construction section, National Safety Council.

Russell S. Conrad has resigned as executive secretary of the Pennsylvania Society of Professional Engineers after a service of six years. Vice-president Victor J. Snyder has been elected as his successor. New chapters of the state society have been organized at York, State College and Pottsville, with a chapter in the process of development at Williamsport.

Sprigg C. Ebbert has been elected president of the Engineers Club of Birmingham, Ala.

Campbell K. Sharp has been reelected chairman of the Memphis Section of the American Society of Engineers.

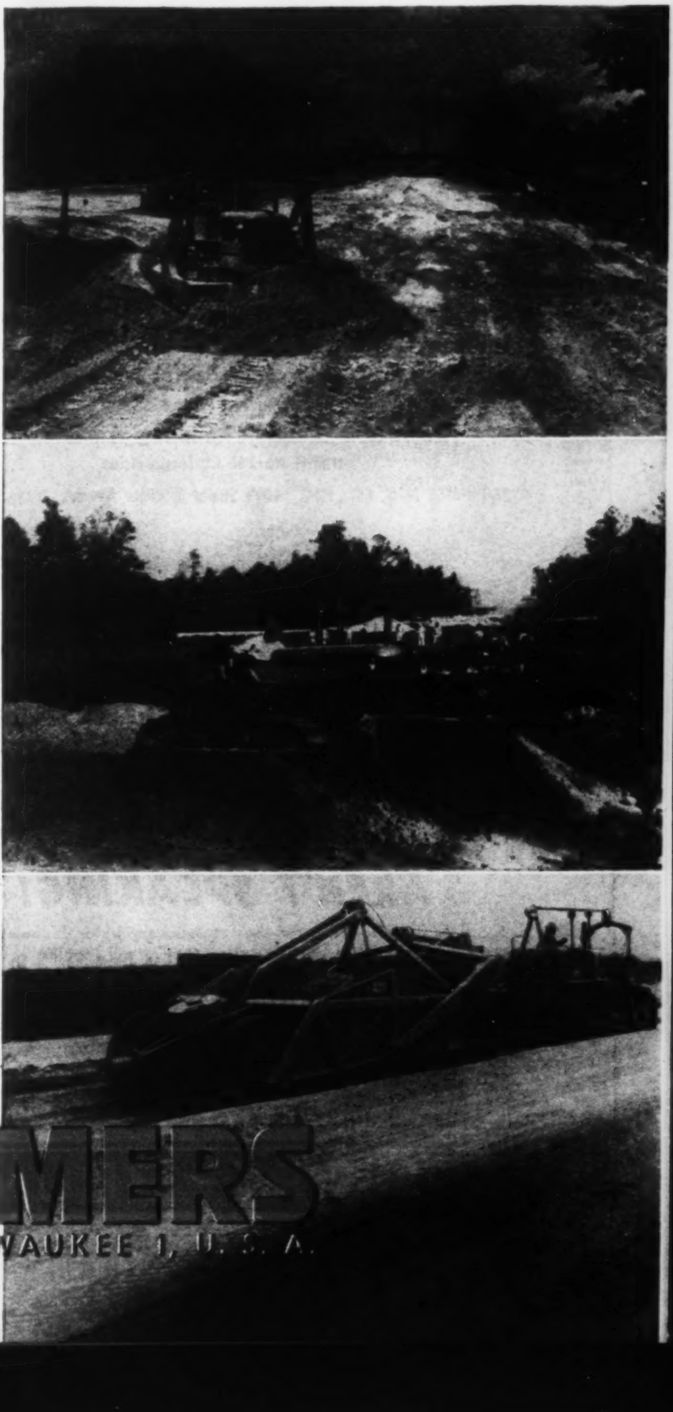
Other executive officers are J. J. Thomason, vice chairman, and James A. Dew, secretary and treasurer. Named to the board of directors are Emmet W. Elam of Whitehaven; Ralph M. King, Memphis; Col. G. R. Schneider and John H. Tole, both of Little Rock.

Arthur C. Sartore was elected chairman of the membership committee, and H. B. Eiland, vice chairman.

BALANCE

makes Every Load a Bigger Load

. . . . Every Job an Easier Job!



A highly profitable tractor to own . . . a pleasure to operate — that's the CORRECTLY BALANCED HD-10!

EVERY LOAD BIGGER!

Extended track and addition of approximately a half-ton in properly distributed weight provides ground-gripping traction, more lugging and pushing ability.* Makes it a better performer with any equipment . . . on every type of soil.

EVERY JOB EASIER!

Operators especially like its smoother, easier riding and performance. They get more done with less effort. Wear and tear on tractor and auxiliary equipment is cut to a minimum, too!

This all adds up to greater output, more profit. Your Allis-Chalmers dealer will be glad to give you complete information . . . NOW!

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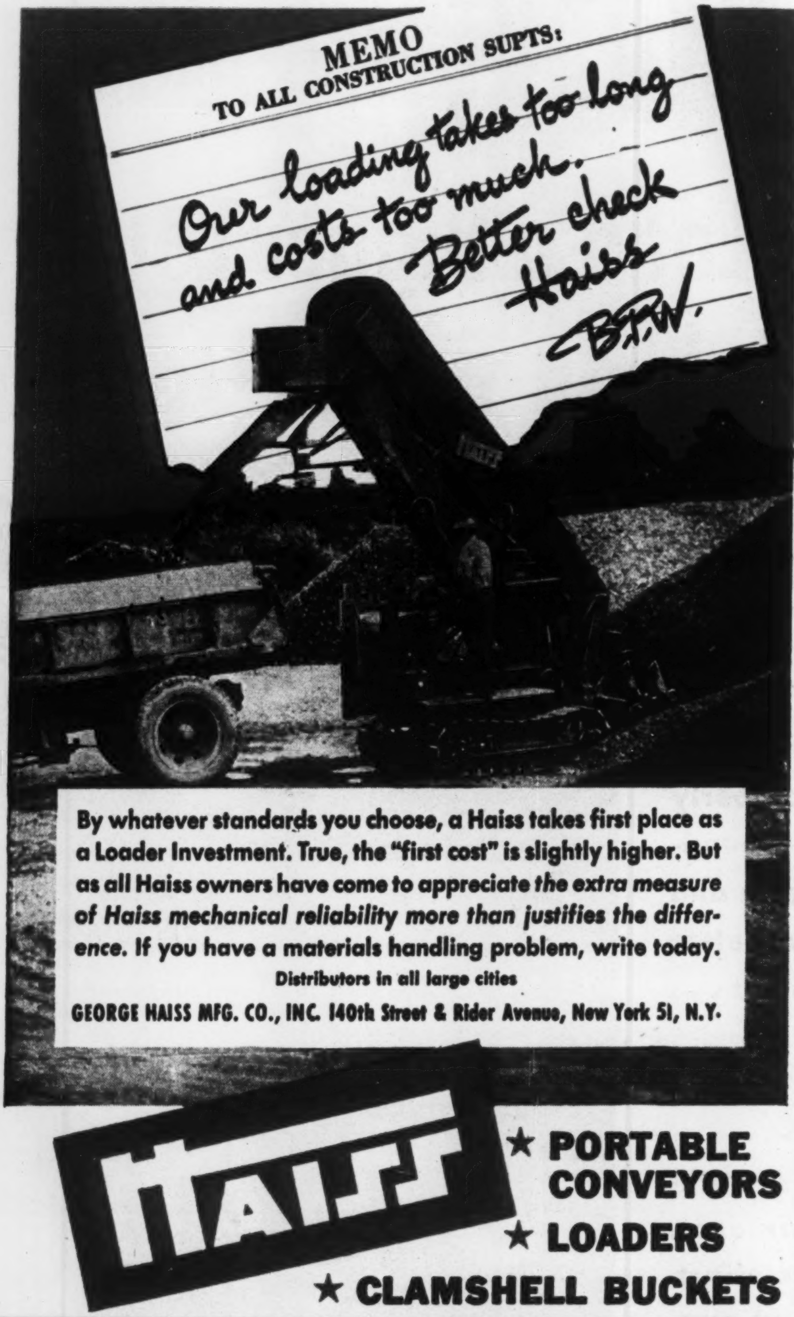
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TO ALL CONSTRUCTION SUPTS:
Our loading takes too long and costs too much. Better check Haiss
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HAISS
★ PORTABLE CONVEYORS
★ LOADERS
★ CLAMSHELL BUCKETS

By whatever standards you choose, a Haiss takes first place as a Loader Investment. True, the "first cost" is slightly higher. But as all Haiss owners have come to appreciate *the extra measure of Haiss mechanical reliability more than justifies the difference.* If you have a materials handling problem, write today.

Distributors in all large cities

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AL BRUMLEY and FRED STUART
AREN'T SPEAKING!

They're too busy getting ready for the revolutionary water coagulator which you'll be using come fall. And, at the same time, they're still keeping up the high standard of service which you've come to expect of Stuart-Brumley when you order Activated Alum, Blackalum, Palmer Filter Bed Agitators, and the amazing new Automatic Water Sampler. (Electric . . . takes samples 24-hours a day . . . keeps accurate check on bacterial count . . . needs no operator)

SO . . . .

Order Now From

STUART-BRUMLEY CORP., 516 N. Charles St., Baltimore 1, Md.

STUART — BRUMLEY

Manufacturers' Activities

First showing and demonstration of a huge dynamometer truck designed by Goodyear to test the range of large tires and wheel equipment used in off-the-road service was conducted for engineers and officials of The Heil Co., Milwaukee. Shown here inspecting some of the measuring devices is Julius P. Heil, Director of The Heil Co., (center) flanked by (left to right) Mel Wilson, Warren Coburn, Karl Feise, Goodyear, Akron, research and development engineers, and Harry Powell, resident sales engineer for Goodyear.

American Institute of Steel Construction, Inc., announce the opening of their district office, 1617 Pennsylvania Blvd., Philadelphia 3, Penna. Henry J. Stetina is district engineer.

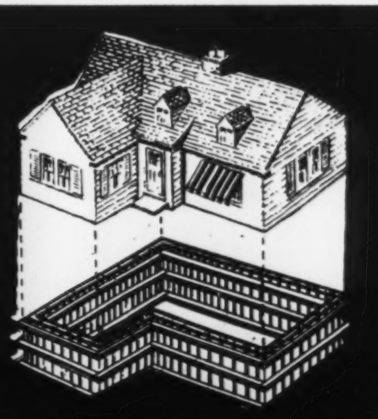
Frederick W. Taylor has resigned as district manager of Chain Belt Co., Atlanta office, to become general manager of the Augusta Iron Works, Augusta, Ga. Mr. Taylor will be succeeded by James S. Moore and Orville Lorenze will continue with the Atlanta office. Augusta Iron Works recently purchased the Lombard Iron Works which has been in continuous operations since 1856.

Air Vice-Marshal J. A. Sully, CB-AFC-former member of the R.C.A.F. Staff has started a plant at Goderich, Ont., for manufacturing road building equipment, graders, bulldozers etc.

Three changes in executive personnel of the Dravo Corp. have been announced: W. D. Bickel, manager of the power department; T. L. Hartman manager of the piping department of the machinery division; W. G. Greer, assistant labor relations manager for the corporation.

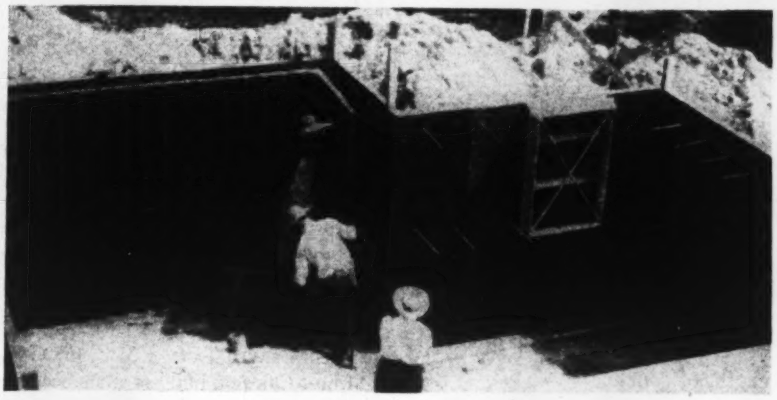
Inland Steel Co. announces the closing of its Cincinnati office, effective August 15. Several northwestern coun-

A Poured Concrete Foundation Complete in ONE Day



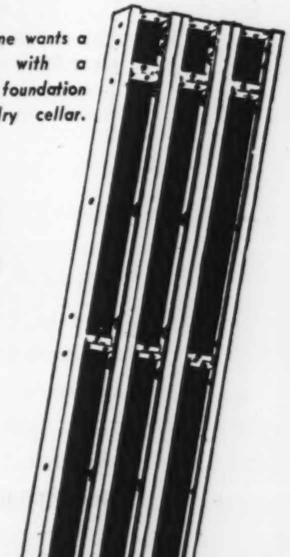
ATLAS LABOR-SAVING *SPEED* FORMS

For Rent or Sale



Easy to set up, strip and move. Light weight, averaging only 35 lbs. per unit. Inserts easily and accurately accommodated. Strong—no studs or joists required as with wood forms. Durable—can be used over and over indefinitely. Leave a smooth uniform finish—No Grain Marks — Nothing to Remove.

Everyone wants a house with a sound foundation and dry cellar.



3 UNITS ATLAS SPEED FORMS

Some New Users

- H. K. Ferguson Eng. Co., Cleveland, Ohio—Sherwin Williams Plant, Cleveland, Ohio, Homer T. Borton, Arch.
- Wigton Abbot Co., Celanese Corp., Bldg., Belvedere, N. J.
- F. H. McGraw, Oceanport, N. J., Monmouth Park Jockey Club
- Brown & Matthews, Inc., N. Y. C.—E. R. Squibb Plant, New Brunswick, N. J.
- Hillsmith & Co., Dayton, Ohio—Sears Roebuck & Co. Store, Dayton, Ohio, Nimmons, Carr & Wright, Arch. Engrs.
- Donald M. Love, Philadelphia, Pa. Housing Project.
- Benoit's Red-E-Mix Concrete Co., Bontiful, Utah, Housing Project.
- Henry W. Streeter, Cor., Elmira, N. Y.—Moore Business Forms, Bldg., Duane Lyman & Assoc., Arch.
- Island Dock Co., Inc., N. Y.—Swimming Pools Kingston Contracting Co., Lebanon, Pa.—Dam
- Gunite Service Corp., Philadelphia, Pa.—Housing Project

A HOUSE FOUNDATION a day at a tremendous saving in cost is easy with Atlas SPEED Forms—the new process for concrete construction which makes it simple to strip, move and set up form work accurately to suit any building condition.

In heavy construction, too, contractors are amazed at the savings they make and order again and again. Savings of 25% and more are not unusual in apartment house, department store, factory and water work construction. Ask any of the users and find out first-hand.

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WHICH WILD BOAR survives when both are so powerful? The one with the *extra* strength, of course.

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ROCHESTER WIRE ROPES are *extra* strong because of something *extra* in the men who make them (skill and care) . . . something *extra* in the materials they're made with (certified high quality) . . . something *extra* in the manufacturing methods (best by the test of experience) . . . something *extra* in the machines they're made on (the most modern in the wire rope industry). Extra strong Rochester wire ropes in all sizes, types, grades and constructions are available for prompt shipment. Rochester Ropes' engineers can advise you on your special problems of wire rope selection, use and maintenance.

LOCKED-IN LUBRICATION is forced by air pressure between individual wires. This process requires twice as much lubricant as is absorbed by other methods . . . protects against internal friction caused by rope passing over sheaves . . . assures longer life and better service from wire ropes made by Rochester.

ROCHESTER *Ropes*
CULPEPER, VIRGINIA
Branch Offices & Warehouses: *Birmingham, Houston, Jamaica, N. Y., San Francisco*

ties of the state of Ohio, formerly handled by this office, will be transferred to the company's Detroit office. The remainder of the territory, including Cincinnati, Dayton and Columbus, will be transferred to the company's Indianapolis office. John S. Gregg, district sales manager will be transferred to the company's Milwaukee office as assistant district sales manager. L. W. Schellhammer will become resident salesman in Cincinnati, operating from the Indianapolis office.

H. W. Lewis Equipment Co. announces that the manufacturing phase of its business, which consists of the making of the Pierce Bear tandem road rollers and other construction equipment, has been incorporated under the name of Lewis Manufacturing Co. and will continue to be located at 415 Hoefgen Ave., San Antonio, Texas.

R. G. LeTourneau, Inc. of Peoria, Ill., has received for the second time this year one of the nation's highest industrial advertising honors. The National Industrial Advertisers Association named the firm a winner in the product advertising division of its 23rd annual conference and exhibit "for the advertising campaign which, in the opinion of the Jury of Awards, is conspicuous for the excellence of its planning and execution."

The Graver Tank & Mfg. Co., Inc., of East Chicago, Ind. has announced the appointment of Edward W. Welp to the position of sales manager of Water Conditioning Equipment. Mr. Welp has spent 32 years with the firm in every phase of research, design and construction of water conditioning equipment.

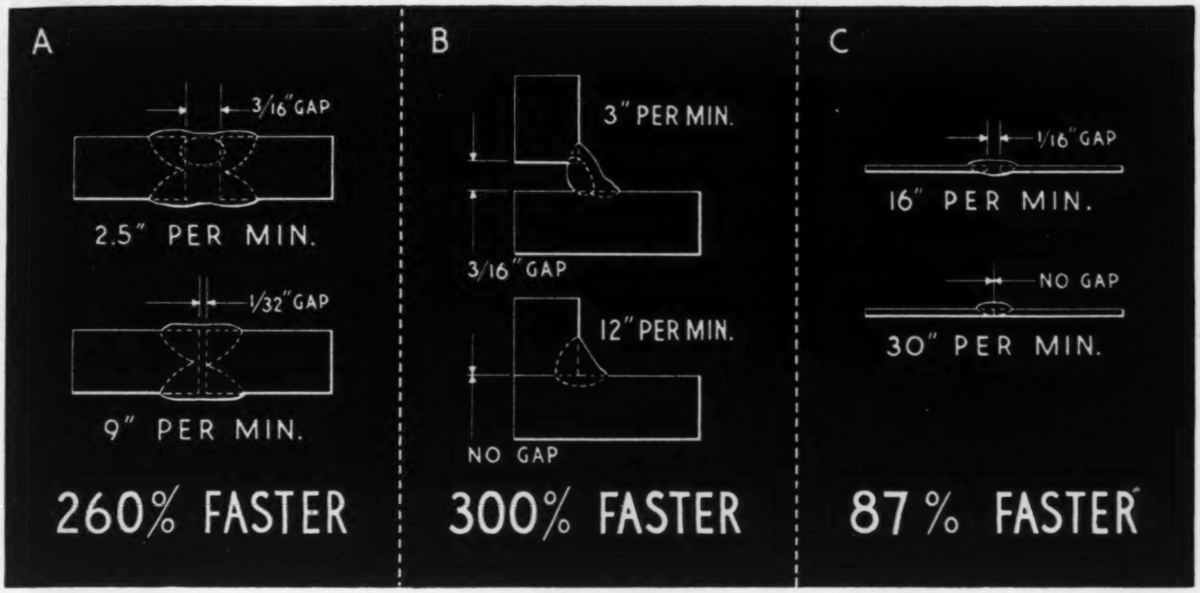
A new oxygen cylinder filling station and Prest-O-Lite acetylene-producing plant is being constructed for The Linde Air Products Co., at Boise, Idaho. The new facilities are expected to be [illegible]mpletely by the latter part of 1946.

Bernard E. Gray, general manager of The Asphalt Institute, announces the appointment of Edward M. Howard as District engineer for the territory comprising the six New England states. At the Boston office of the Institute, Mr. Howard will be equipped to extend the engineering, research and promotional facilities of The Asphalt Institute to highway engineers and contractors.

Charles S. Pillsbury, Chicago Bridge and Iron Co., Chicago, Ill., has been elected executive vice-president. He has been a director of the company for several years.

MR. STRACHEY: **Here's food for thought to help you get the full measure of competitive advantage from arc welding:**

GET GOOD FIT-UP



Care in cutting, forming and fitting up of plates and shapes to be welded pays big dividends. By improving fit-up of joints, you increase welding speed and thereby cut costs and minimize distortion.

EXAMPLE A—This square butt joint in ⅜" plate with gap of 3/16" is made at an arc speed of 2.5" per min. With recommended gap of 1/32", speed is 9" per min.... 260% faster.

EXAMPLE B—This fillet weld in ½" plate, with 3/16" gap, is made at an arc speed of 3" per min. With no gap, speed is 12" per min.... 300% faster. Both welds have a 5/16" throat.

EXAMPLE C—This butt joint in 14 ga. sheet, with 1/16" gap, is made at an arc speed of 16" per min. With no gap, speed is 30" per min.... 87% faster.

The sign of abundance. When you see 3 DOTS on an electrode, you know you have genuine "Fleetweld" ... the world's leader for *low cost, speed* and *quality*. "Fleetweld" incorporates the full measure of Lincoln's pioneering research and worldwide engineering experience.

Handy pocket manual, giving, "Fleet-Welding" procedures for all types of joints in mild steel, free on request. Ask for Bul. 444.

THE LINCOLN ELECTRIC COMPANY • DEPT. 334 • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

BRIGGS & STRATTON ENGINES

the "Key"

TO LONG DEPENDABLE PERFORMANCE

The successful operation of any gasoline powered appliance, farm machine or industrial equipment depends on good engine performance day after day. The proved performance record of over 2½ Million Briggs & Stratton *air-cooled* engines, built during the past 26 years, is the reason why users, dealers and manufacturers have made Briggs & Stratton powered equipment their *first choice* — and have established Briggs & Stratton engines everywhere as the Right Power for hundreds of applications.

Be assured of years of dependable, trouble-free performance by waiting until you can have equipment powered by Briggs & Stratton engines. You will not have to wait very long — because deliveries are improving with the increased production now flowing out of our factories.

BRIGGS & STRATTON CORP., Milwaukee 1, Wisconsin, U. S. A.

Air-Cooled Power

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

Manufacturers' Publications

Steel Products—Establishment of the Pacific Rolling Mills in 1866 by a group of San Franciscans marked the inception of the iron and steel industry on the West Coast. Growing up with the country, and contributing greatly to this growth, this company joined forces with the Judson Mfg. Co., became known as Judson-Pacific Co. and then the Judson Pacific-Murphy Corp. The latter company has recalled its proud antecedants in a book entitled *"The Romance of Steel in California"*, full of ancient and modern pictures of historic events and the company's part in them. Starting out by converting scrap into iron, they later made the rails for San Francisco's first cable cars, then branched out into steel making in 1884, and after the 1906 earthquake and fire furnished most of the steel for rebuilding the city. Later they shared in the steel fabrication for the Golden Gate and Bay Bridges, for new office buildings and for factories on the West Coast. Electric cranes and loading craft were some of its war products. The J. Philip Murphy Corp., which has recently come into the organization, placed the reinforcing steel in Shasta Dam and dismantled the Tacoma Bridge towers.—*Judson Pacific-Murphy Corp., San Francisco, Calif.*

Manual Planning—"How to Plan an Owner Manual" is title of 24-p. technical guide book. It contains valuable suggestions on what to include and how to present information in most effective way including sample pages of illustrations. Guide is designed to be used as work book with space for filling in and laying out information that would apply to user's particular product.—*Ken Cook Co.,* 710 *N. Plankinton Ave., Milwaukee* 1, *Wis.*

Clamshell Bucket — Advantages of modern all-welded construction in design of clamshell buckets are analyzed in 8-p. booklet. Complete specifications for general purpose, rehandling and heavy-duty digging buckets are given. —*C. S. Johnson Co., Champaign, Ill.*

Loudspeakers — Featured in 24-p. catalog are super-power speakers, driver units, reflex loudspeaker trumpets, radial reflex projectors, industrial paging speakers, radial communication speakers, submergence and explosion proof speakers.—*University Loudspeakers, Inc., 225 Varick St., New York 14, N. Y.*

Emulsified Asphalt — Illustrated 8-p. bulletin describes five methods for using Bitucote: Penetration, road mix, plant mix, surface treatment, and base stabilization. Examples are given of its use for playgrounds, railroad grade crossings, highways and streets, airports and industrial floors.—*Bitucote Products Co., Engineering Dept., 1411 Central Industrial Drive, St. Louis 10, Mo.*

Industrial Rubber Products—Pocket-size 28-p. booklet lists company's lines of flat transmission belting, conveyor belting, V-belts and sheaves, hose and couplings, adhesives, Plastikon rubber putty, industrial clothing, and other products.—*The B. F. Goodrich Co., Akron, Ohio.*

Two-Stage Centrifugal Pumps — —Two-color, 16-p. catalog describes Class GT pumps for general use, as station pumps in mines, for condensate service in power plants, and as hydraulic pumps on elevators. Tables cover performance, dimensions and pipe friction. A typical pumping problem is worked out in detail—*Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.*

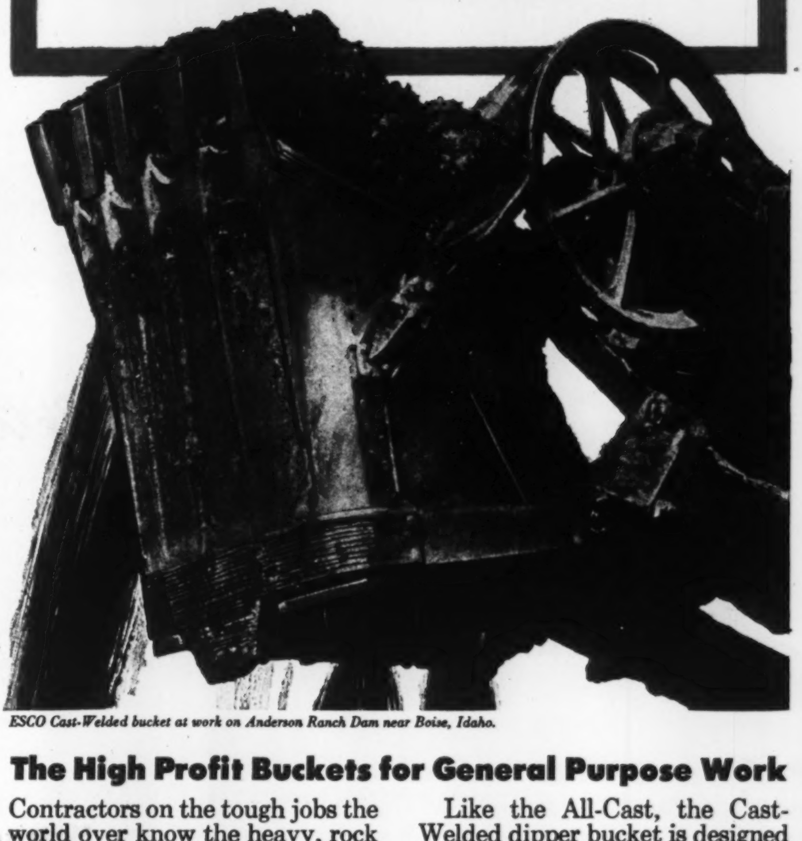
Road Maintenance and Construction Equipment — Illustrated folder describes three units for constructing and repairing airport runways, highways, roads, streets, and parking areas. They are Model 84-HD kettle, Model 155 trail-o-roller, and Model 101 utility spray tank.—*Littleford Bros., Inc., 457 E. Pearl St., Cincinnati, Ohio.*

Trailers — A 64-p. catalog contains pictures and detailed description of six different underconstructions offered in 1946 trailer line, including new gravity suspension, tandem and multi-rate single axle unit. Specifications outline body types available, including tank and dump trailers; stake and rack models; oil field floats; and carryalls.—*Fruehauf Trailer Co., Detroit, Mich.*

Pneumatic Tools — Units made by Machinery Products Division are covered by 24-p. catalog. Pictures, descriptions and specifications are given for pneumatic drill, screw driver, riveting hammer, and small accessories.—*Ideal Industries, Inc., 1296 Park Ave., Sycamore, Ill.*

Motor Grader — Capacity, performance and design of newly improved AD motor grader are stressed in 32-p. cata-

ESCO cast-welded
DIPPER BUCKETS



ESCO Cast-Welded bucket at work on Anderson Ranch Dam near Boise, Idaho.

The High Profit Buckets for General Purpose Work

Contractors on the tough jobs the world over know the heavy, rock type *ESCO* all-cast dipper bucket that stands up under the hardest beating. But fewer are familiar with the newer, lighter Cast-Welded bucket, which is designed for less severe all purpose work.

All parts subject to wear and shock are cast of manganese steel, get harder and tougher the more they work. The box section is fabricated from heavy alloy steel, strongly reinforced on top and both sides with cast alloy hollow-beam sections.

Like the All-Cast, the Cast-Welded dipper bucket is designed for greatest efficiency. Flaring teeth give a clean bite the entire width of the dipper. Cutting lip has streamlined integral tooth holders. Tapered box loads easily, discharges quickly; material does not hang up. No excess weight anywhere, assuring maximum pay load and faster digging.

For further information, get our catalog No. 156, which gives complete construction data. Ask your nearest *ESCO* representative, or write us direct.

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SPECIALISTS IN APPLIED METALLURGY
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Elliott 4161

HONOLULU, 5
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Phone 6486

NEW YORK, 17
Graybar Building
Lexington 28958

SAN FRANCISCO, 7
699 Second Street
Douglas 8346

SPOKANE, 8
121 S. Monroe St.
Main 5530

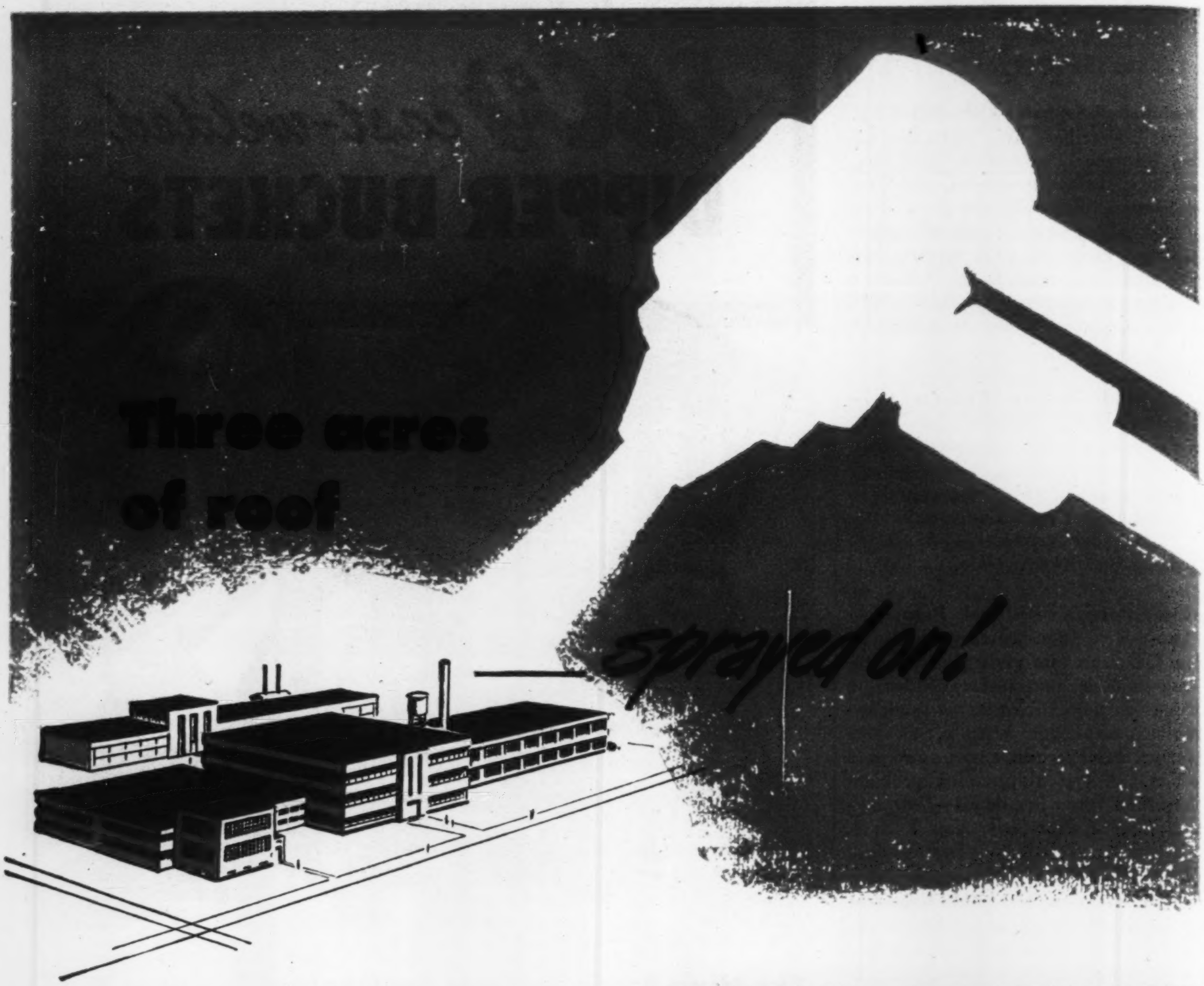
LOS ANGELES, 11
4600 Pacific Blvd.
Lucas 7251

CHICAGO, 1
221 N. LaSalle St.
Dearborn 2284

EUGENE, ORE.
1991 Sixth Ave., W.
Phone 5012

IN CANADA— ESCO LIMITED, 1084 Homer St., Vancouver, B. C. Telephone Marine 2343

Three acres of roof



A huff, and a puff . . . and you *blow* the roof on. At a real saving in application costs!

Years ago Flintkote introduced the first practical Cold Process Built-up Roof, speeding up application enormously, and eliminating heating equipment dangerous to men, materials and structures. Its superiority has been established, on thousands of roofs, by the acid tests of time and weather.

Now, Flintkote pioneers again . . . with Cold Process Roofs, both for new construction and for maintenance, APPLIED BY SPRAY.

Now . . . with Nu-Static* Roof Coating and Fibrex* II Adhesive designed especially for Spray Application, Flintkote provides an even more rapid, *mechanical* means of assembling what amounts to a "pre-fabricated" roof.

Spray Application has been thoroughly tried and proved. It gives you a glassy-smooth Cold Process Roof. (Far smoother than hand finish.) Saves up to 50 per cent of application costs! And height of building is no limiting factor.

Write for full information on how spray application of Flintkote Cold Process materials results in better roofs at lower application costs. The Flintkote Company, 30 Rockefeller Plaza, New York 20, N. Y. Offices in principal cities.

*Trademark

FLINTKOTE BUILDING MATERIALS

FLINTKOTE

the extra years of service cost no more!

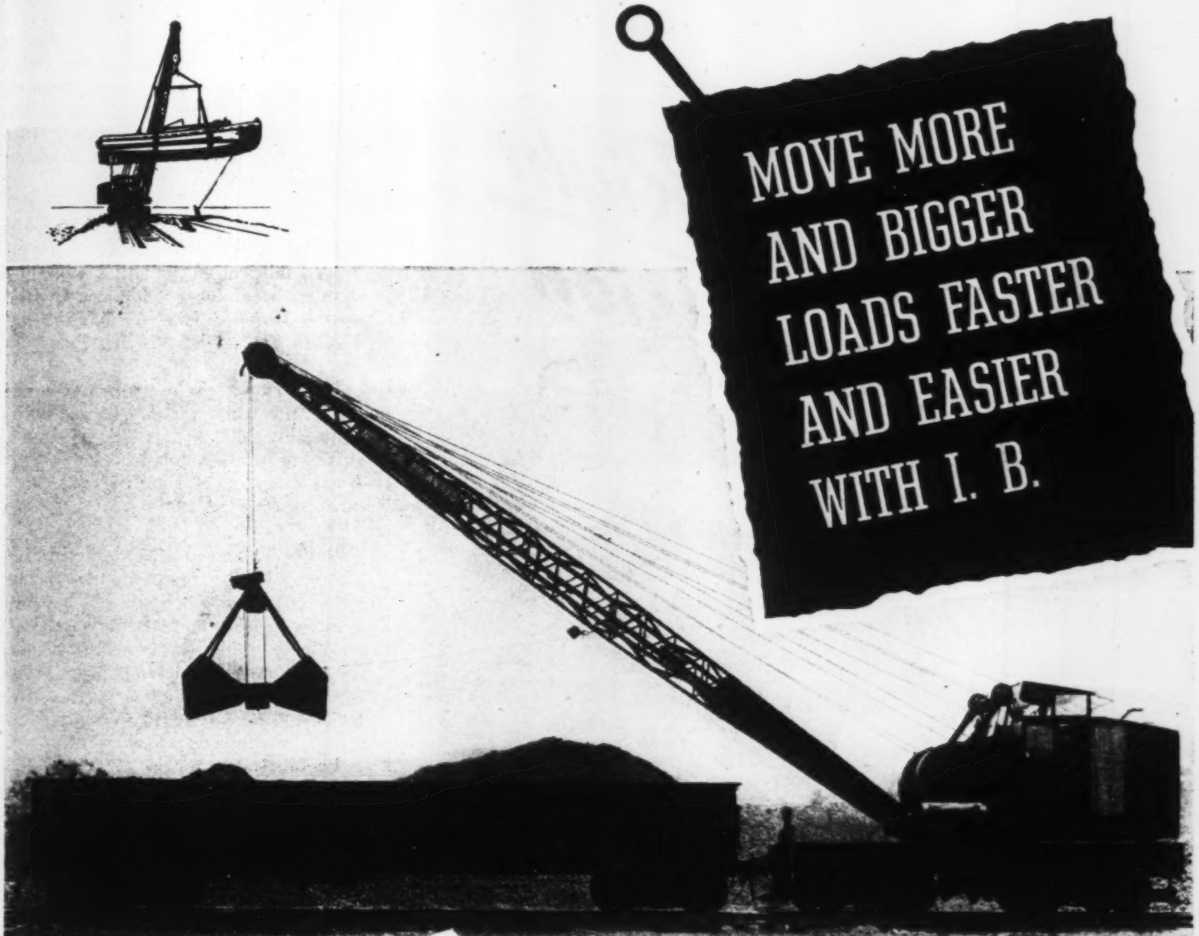
Flintkote Quality Building Materials For Many Purposes

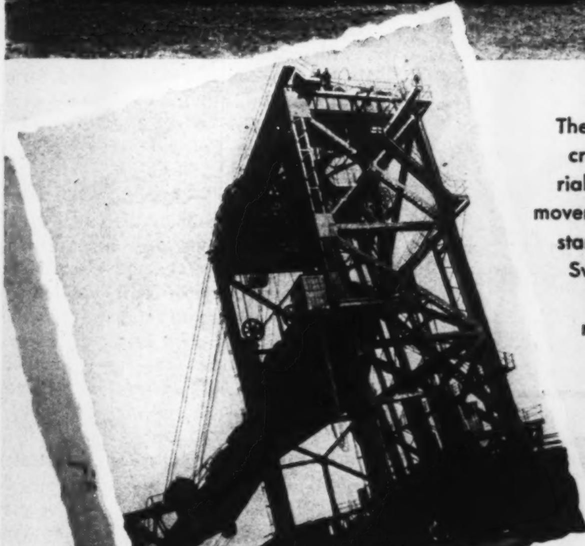
Flintkote Asbestos-Cement Shingles and Siding are ideal for new construction . . . or for modernizing existing homes.

Flintkote Thickbut Shingles come in a wide variety of colors. Extra home protection with built-in double thickness of the butts.

Flintkote is deep rooted . . . and still growing. A 16 million dollar plant expansion program now under way!

A complete line of thermal insulating materials . . . Asphalt Coated Sheathing, Insulation Lath, Roof Insulation, Insulating Wool.

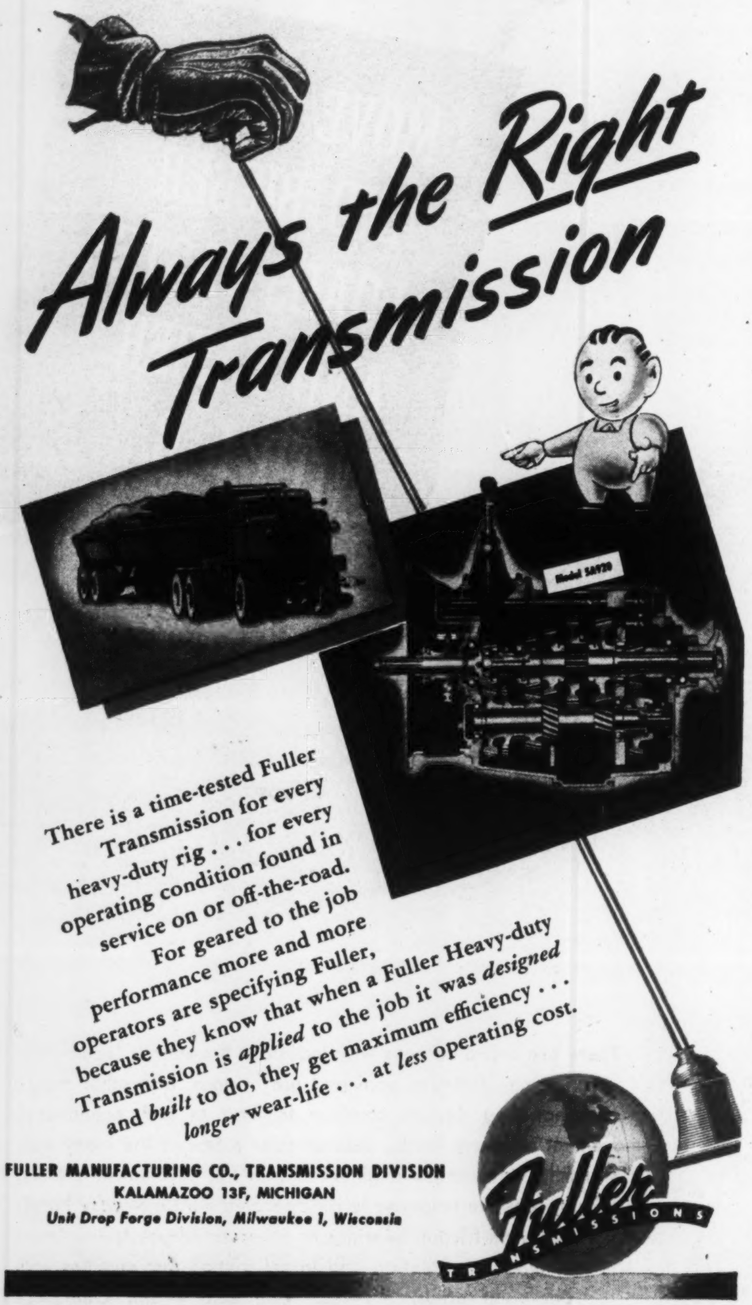




There are sound reasons why Industrial Brownhoist locomotive cranes, car dumpers, coal and ore bridges, and other materials handling devices continue to lead in fast, economical movement of heavy loads. Just consider a few of the many outstanding advantages engineered into I.B. locomotive cranes. Swift, sensitive response to air-operated controls—easy handling! Anti-friction bearings at all essential points—minimum maintenance! Rotating and travel friction disc clutches with one-point adjustment—less wear and strain! One-piece massive cast steel bed—insures rigidity of mechanism! Patented Monitor-type cab—safe 360° visibility! For expert assistance in solving your special or general purpose materials handling problems, get in touch with Industrial Brownhoist—first! • This giant I.B. Great Lakes type car dumper typifies the power, strength, and stamina that are designed and built into all Industrial Brownhoist equipment. It handles loaded coal cars up to 120 ton capacity, lifting and dumping them like toys.

INDUSTRIAL BROWNHOIST BUILDS BETTER CRANES

INDUSTRIAL BROWNHOIST CORP. • BAY CITY, MICH. • District Offices: New York, Philadelphia, Cleveland, Chicago • Agencies: Detroit, Birmingham, Houston, Denver, Los Angeles, San Francisco, Seattle, Vancouver, B.C., Winnipeg, Canadian Brownhoist Ltd., Montreal, Quebec.



There is a time-tested Fuller Transmission for every heavy-duty rig . . . for every operating condition found in service on or off-the-road. For geared to the job performance more and more operators are specifying Fuller, because they know that when a Fuller Heavy-duty Transmission is *applied* to the job it was *designed* and *built* to do, they get maximum efficiency . . . *longer* wear-life . . . at *less* operating cost.

FULLER MANUFACTURING CO., TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN
Unit Drop Forge Division, Milwaukee 1, Wisconsin

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For ● Steel Plate Lining ● Steel Encasement ● Building Walls, Roofs, Facings ● Tunnel Lining ● Water Reservoir Lining ● Power Plants—Bunker Lining ● Sewer Repairs ● Tank Lining ● Canal and Ditch Lining ● Repairs of Disintegrated Concrete, Brick, Tile, Masonry

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log, which gives special attention to clearance, blade construction and range, electric brakes, sturdy frame and General Motors 2-cycle, 75-hp. engine providing speeds up to 17 mph.—*Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee 1, Wis.*

All-Welded Fabrication—File-folder bulletin shows several types of all-welded fabrication including all-welded stainless steel for outside construction work.—*Minweld Steel Co., Shaler and Wabash Sts., Pittsburgh 20, Pa.*

Lift Truck—Folder announces new LT-35 lift truck which can lift, carry and stack 1,500 to 2,000-lb. loads. It is smallest of company's line.—*Towmotor Corp., 1226 E. 152nd St., Cleveland 10, Ohio.*

Boiler Tubes—An 8-p. bulletin gives information on enlarged boiler tube service of company, which has been appointed distributor of B. & W. electric resistance welded boiler tubes. Tubes in stock are listed and described.—*Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80. Ill.*

Prefabrication—The "Wilson System" of forms for constructing prefabricated sectional building units is described in 4-p. circular. Forms are said to be ideally adaptable for either site construction or factory mass production, as they are portable, interchangeable, reusable and collapsible. Drawings show recessed section forms, wall section, aggregate sections, wall installation and assembly, steel forms and adjustable bottomless pan for recessed section.—*Wm. M. Wilson, 253 S. Hoover St., Los Angeles 4, Calif.*

Job Records—Actual job experiences of eight major contractors on 25 completed projects are assembled in 12-p folder for study and comparison. Contractors' records and opinion regarding Tournapull versatility, economy and long life are presented, as well as information about various methods used.—*R. G. LeTourneau, Inc., Peoria, Ill.*

Photoelectric Control—Illustrated sheet tells about Photoswitch Series 20 and 21 photoelectric controls for general industrial and machinery applications. Specifications and dimensional sketches are included.—*Photoswitch, Inc., Cambridge 42, Mass.*

Slip Ring Motor—Illustrations and descriptions of parts are given for 1- to 350-hp. slip ring induction polyphase motors. Operating characteristics are listed.—*Century Electric Co., St. Louis 3, Mo.*

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